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Canada, Montreal Harbour Commission

ANNUAL REPORT
OF THE
Harbour Commissioners
of Montreal

For the Year 1915



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COMMISSIONERS
W. G. ROSS, Esq., President
FARQUHAR ROBERTSON, Esq. Brig.-General A. E. LABELLE



OFFICIALS

MAJOR DAVID SEATH, SECRETARY-TREASURER
M. P. FENNELL, JR., ASSISTANT SECRETARY

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T. W. HARVIE, ASSISTANT CHIEF ENGINEER

J. NEHIN, GEN'L SUPT. OF GRAIN ELEVATORS
GEO. GENDRON, MECHANICAL SUPERINTENDENT

CAPT. T. BOURASSA, HARBOUR MASTER
CAPT. J. F. SYMONS, DEPUTY HARBOUR MASTER

GEORGE E. SMART, COMPTROLLER

ROBT. A. EAKIN, PAYMASTER AND WHARFINGER

J. VAUGHAN, SUPT. OF RAILWAY TERMINALS
R. L. MERCIER, ASST. SUPT. OF RAILWAY TERMINALS

L. H. A. ARCHAMBAULT, PURCHASING AGENT

Harbour Commissioners of Montreal

MONTREAL, February 1st, 1916.

To Hon. J. D. HAZEN, K.C., M.P.,
Minister of Marine and Fisheries,
Ottawa, Ont.

Sir,—

In compliance with Section 51 of the Commissioners' Act 57-8 Victoria, Chapter 48, the Harbour Commissioners of Montreal herewith respectfully submit their Annual Report of Operations for the year ended 31st December, 1915.

We have the honour to be,

Sir,

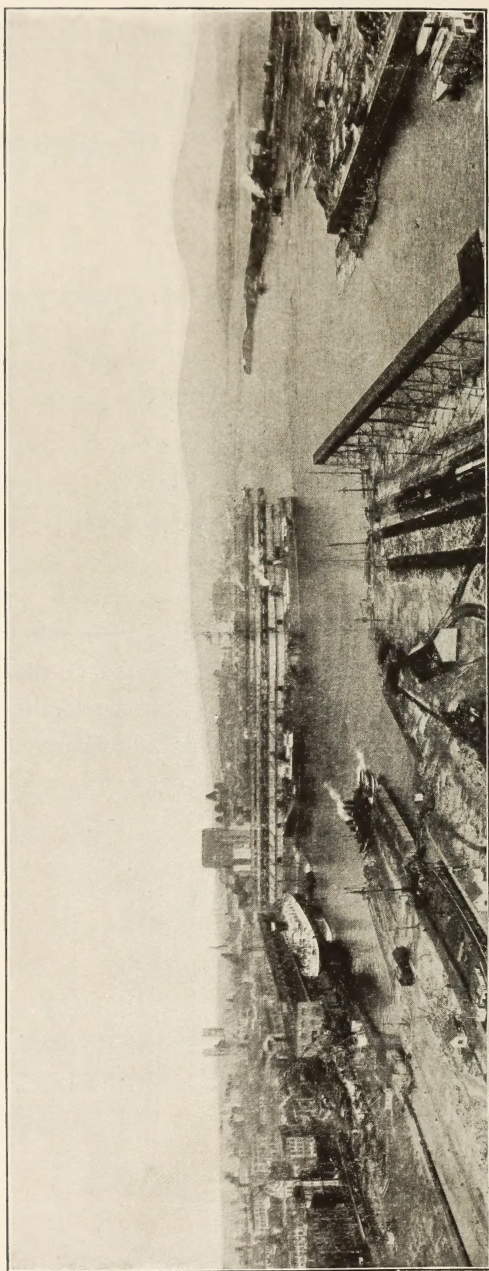
Yours very respectfully,

W. G. ROSS, President.

F. ROBERTSON,

A. E. LABELLE,

Commissioners.



General View of the Harbour from the Grand Trunk Elevator

REPORT OF OPERATIONS

CARRIED OUT BY

Harbour Commissioners of Montreal

1915

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THE altered commercial and financial conditions, referred to in the last Annual Report, caused by the outbreak of hostilities in the Old World, have continued throughout the year 1915, during which the greatest attention was given by the Commissioners to facilitating the forwarding of supplies to the Motherland and the Allies.

The year 1915 has been a complete War Season. Passenger ships have in a great measure given way to transports. The regular liners have given way to chartered substitutes. Tramps were unobtainable in sufficient numbers. Capital expenditure on new industrial developments in Canada having been reduced to a minimum, imports through the Harbour were greatly decreased. Owing to lack of tramp tonnage towards the close of the season, the phenomenal grain crop of Canada could not be shipped in proper measure by the St. Lawrence route.

On the other hand, the season's results are not discouraging. The Railway Terminal operating results have been the best on record. The industries along the Harbour front have greatly increased their use of the Harbour

Terminals for shipping to the different railways and to and from the ships in the Harbour.

The mechanical activities in Canada have resulted in large shipments through the Port of Montreal, and the shipments of food products and supplies have been very heavy.

Protective measures were taken for the care of the valuable property in the Harbour, and through the anxious times business was carried on as usual.

SEASON OF NAVIGATION.

The season of navigation opened on the 11th of April, when the steamer "Longueuil" arrived from her winter quarters. The S.S. "Cascapedia" reached the Port on the 24th of April from the Maritime Provinces, and on the 30th of April the S.S. "Thespis" steamed into the harbour, her Commander, Captain H. C. Jones, being



View of the Harbour of Montreal as it appeared in the year 1830

presented with the customary token granted to the Master of the first transatlantic vessel to arrive.

The last sea-going vessel to depart from the harbour was the S.S. "Port Dalhousie," which sailed on the 11th of December, this date being the latest on which any sea-going vessel has ever left Montreal, and navigation closed on the 15th December when the Str. "Louis Philippe," the new Longueuil Ferry, left for her winter quarters.

SHIPPING.

The season of 1915 has been one which will live in the memory of those associated with shipping as totally different from any of its predecessors. While in 1914 the effect of the war was hardly felt, sufficient steamships being available for the world's work, in 1915 the cry at every North American port was one for ships, because of the lack of which in the latter part of the summer, the great railroad systems of the United States were reluctantly compelled to declare embargoes on certain classes of commodities at New York, Philadelphia, and other ports.

In all, 815 sea-going vessels arrived in port during the season, with a tonnage of 2,261,374 tons, as against 916 vessels with 2,755,518 tons in 1914, this showing being due to the commandeering and retaining by the British Admiralty for the entire season of important sections of the fleets which, under normal conditions, would have been used to supply the Port of Montreal, as well as to the fact that the maximum results were not procured even from the available tonnage on account of the delays in unloading experienced in the congested English ports.

While strenuous efforts were put forth by the Shipping Companies to fulfill the major part of the demands made upon them by utilizing every inch to capacity, and charter-

ing outside tonnage wherever possible, the shortage of tonnage was more keenly felt at Montreal than at any other sea port, especially as regards the handling of the phenomenal grain crop of Canada, most of which should have passed through Montreal had adequate tonnage been available.

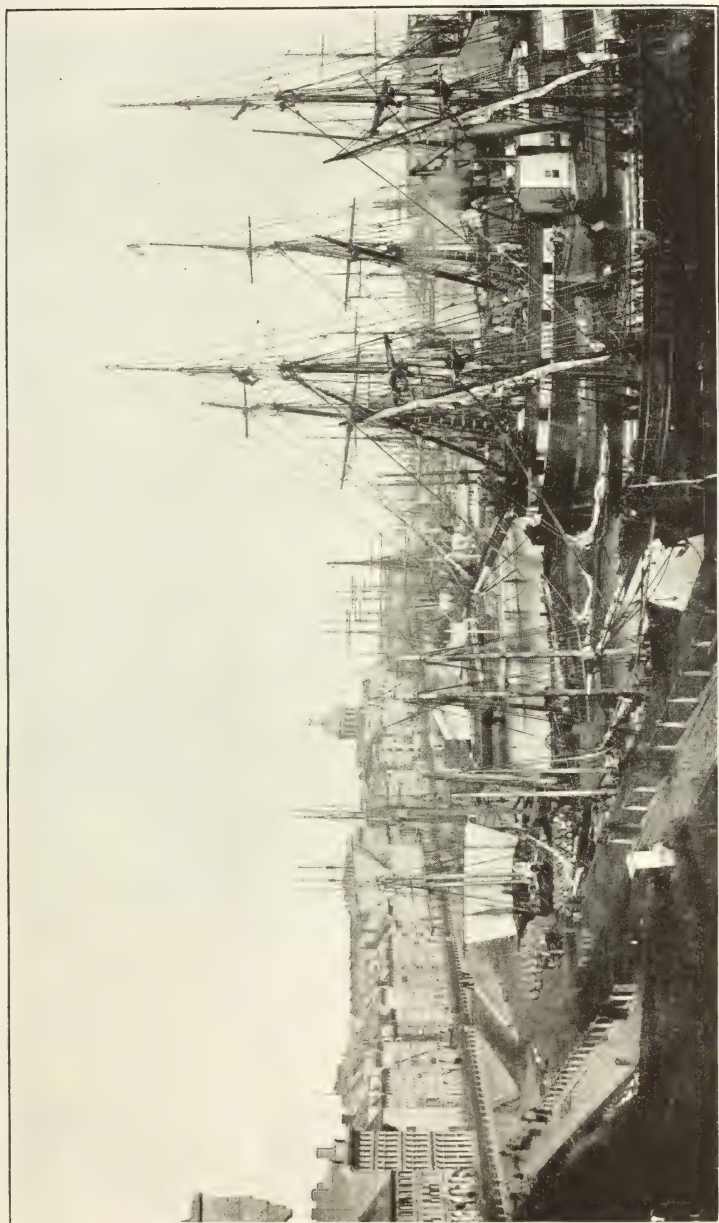
The greatest number of sea-going vessels in Port at any one time occurred on the 21st September, when there were 34 berthed in the Harbour.

The usual statements are hereto appended showing:—

1. The number and tonnage of all vessels.
2. Classification of transatlantic vessels.
3. Classification of vessels from the lower St. Lawrence and Maritime Provinces.
4. Number and tonnage of sea-going vessels and their different Nationalities; also the number of men that manned the vessels.
5. The opening and closing of navigation, the first arrival and the last departure of vessels, and the greatest number in port at one time.

Included in the above statements are 238 tramp vessels which were employed in carrying the following full cargoes from the Port:—

Wheat.....	81
Transports (Government vessels).....	46
Hay and Oats.....	38
Horses.....	33
Cattle.....	11
Oats, flour and seed.....	9
Lumber.....	8
Mixed cargo, oil, rails, canned goods and beef.....	12



Harbour of Montreal in 1872 showing Sailing Vessels

During the season there were transhipped at this Port 29,219 tons of nitrate of soda from Chili, South America, destined to points in the Western States, demonstrating the advantages offered by the St. Lawrence route to Montreal and Canada's deep inland water connection with interior points, only one transshipment being necessary in the entire distance of 10,500 miles.

All things considered, the results of the season's shipping can be viewed with a good deal of satisfaction, and shippers and the public generally, to whom the steady flow of commerce between Canada and Great Britain means so much, must feel deep gratitude for an efficient navy, which alone has made it possible to maintain uninterrupted communication with the Motherland.

NEW STEAMSHIP SERVICES.

A new steamship service was inaugurated during the season by the Head Line, connecting Montreal with the Port of Avonmouth, vessels plying on the same being specially equipped to take particular care of the cheese and provision exports to that port.

The Liverpool route of the Canadian Pacific Steamships was strengthened this year by the addition of the fine new steamer "Metagama," which made its first trip to the Harbour on May 3rd, as well as by the acquisition of the steamers "Medora" and "Mattawa," and the chartering of the "Knight of the Thistle," "Avristan," "Indore" and "Ikbal."

Two large modern steamships at present under construction at Belfast have also been purchased by the Company, and it is expected that they will be ready for service early in 1916.



S.S. Metagama on Maiden Trip

Much satisfaction was expressed during the season by residents of Longueuil with the new Longueuil Ferry, the steamer "Louis Philippe," belonging to the Canada Steamship Lines, Limited, which went into service on May 1st.

INSURANCE RATES.

Under normal conditions, the most serious handicap placed upon Canadian business through the Port of Montreal is the excessive insurance rates levied upon hulls and cargoes, particularly during the opening and closing months of the season, and although repeated representations have from time to time been made to the large Insurance Companies and Marine Underwriters, the answer has always been that the rates would automatically adjust themselves as soon as the loss experience warranted.

While certain reductions have occurred since 1900, when the basis of the rates at present in force was fixed,

they still remain at a point highly prejudicial to the expansion of trade and the increase of new business, and this, notwithstanding the fact that by the establishment of adequate dry dock accommodation in the river, the last substantial argument against lower rates of insurance was met in a practical and business-like manner, affording as it does the desired protection to invested capital in ships now doing business on the St. Lawrence, as well as the ships of larger and greater tonnage contemplated.

Notwithstanding the fact that, in her desire to bring the equipment of her national waterway up to the highest possible standard, Canada has since 1900 spent \$70,000,000 on the St. Lawrence route, and there has been a steady decrease in the losses and accidents, the situation remains unchanged.

The Commissioners are of opinion that Underwriters can well afford to acknowledge the vastly improved conditions of Canadian navigation routes by gradually reducing the rates on hulls and cargoes without detriment to their own interest, and with this object in view early and earnest consideration will be given to the preparation of a concise statement, showing the improvements effected on the St. Lawrence since 1900, as well as the accidents, for submission to the members of Lloyds and The London & Liverpool Institutes of Underwriters, in an endeavour to bring about the readjustment justifiable by present conditions.

Such readjustment should remove from time policies the obnoxious "B.N.A." clause, the absence of which would permit tramp vessels to navigate the St. Lawrence without the payment of an extra premium; and, on the

whole, marine insurance rates to Montreal should be placed on a parity with those assessed shipping to her competing ports on the Atlantic seaboard.

Conference with Mr. J. S. Allen.

In November, when Mr. J. S. Allen, General Manager, Union Marine Insurance Co., Ltd., Liverpool, and Marine Manager, Phoenix Assurance Co., Ltd., London, visited the City, the Commissioners took advantage of the occasion to hold an important conference touching on the discrimination by the Underwriters of the St. Lawrence ports, specially as against tramp vessels, and the heavy increase in the rates in the autumn.

With representatives of the interested corporations in Montreal, Mr. Allen inspected the large floating dock and ship-building and repairing plant of the Canadian Vickers Limited, as well as the docks and facilities of the Harbour. Full information was given as to the welcome strange shipmasters would receive at the Harbour Office and the necessary assistance that would be given. The discussion touched upon the great works of improvement accomplished by the Canadian Government, through the Department of Marine and Fisheries, in deepening and widening the channel and establishing magnificent aids to navigation, and operating the Signal Service System, and all other means whereby the hazards of navigation in the St. Lawrence have been greatly lessened in the last few years.

It is to be hoped that the result of this conference, and others which may follow, will, in the near future, strengthen the efforts being made in the interests of the amelioration of marine insurance rates to the Port of Montreal.

HARBOUR MASTER'S DEPARTMENT.

During the past season of navigation, the entire work of this Department in the assigning of berths to vessels, and the supervising of their loading and unloading, has been performed by the Harbour Master, Captain T. Bourassa, the Deputy, Captain Frank J. Symons, R.N.R., having taken his place at the outbreak of war in the British Navy, where he is now serving on board H.M.S. "Sapho."

POLICE DEPARTMENT.

Organized in 1913, the Harbour Police Force, consisting of two officers and 36 constables, all uniformed, regulates the traffic on the wharves, maintains order and protects life and property within that portion of the Harbour of Montreal situated between the entrance of the Lachine Canal and the Sutherland Pier, a distance of 3½ miles.

Following the rule established on the declaration of war, at the beginning of August, 1914, admission to the Harbour during the past year was restricted to persons holding special passes issued by the Commissioners, which necessitated the placing of police guards at all entrances, their principal duties being to ward off undesirables or suspicious characters, as well as to regulate vehicular traffic at these points.

With the aid of a large number of city constables, special efforts were directed by the Harbour Force to the safety of the property and equipment, as well as the shipping from the Port, and as practically the entire exports of the Port were destined to the Motherland and Allied Countries and for the prosecution of the Empire's war, ceaseless supervision was necessary. On one oc-

casion as many as eleven alien enemies, employed in the coaling of one of the transports, were removed from the harbour.

During the season of navigation the Police attended the arrival and departure of every passenger vessel, and it is a pleasure to be able to state this year again that the Steamship Companies and other large corporations doing business within the Harbour did not have a case of pilferage to report, and as not a single assault was committed, the Harbour was practically free from crime.

On request, the Police also assisted in the supervising of the number of passengers carried on the river and ferry boats, their work in this direction being most satisfactory to all concerned, no incident having marred the season's business.

Notwithstanding the large number of sightseers congregating around the harbour on the sailing of troops, no incident of an unseemingly nature occurred, due to the fact that on such occasions, working in harmony with the Harbour Force, the City Police rendered invaluable aid in keeping the crowds under control, for which assistance the Commissioners desire to thank the Chief of the City Police and his officers.

60 persons were arrested and brought before magistrates and recorders for different minor offenses during the season, in addition to which 20 arrests were made in connection with the smuggling of opium, in the dealing with which offense the efforts of the Harbour Police were most successful, a considerable quantity of the drug being seized and turned over to the customs department.

A proof of the efficiency of the efforts of Chief Coleman and his force is found in the fact that not an accident of any nature occurred due to traffic within the harbour

during the season, notwithstanding the free movement of trains at all hours.

PURCHASING DEPARTMENT.

This Department purchases the materials necessary for the construction work carried out by the Harbour force, as well as the stores required in the operation of the Dredging Fleet, Traffic and other departments and is under the immediate charge of Mr. L. H. A. Archambault, who, working in conjunction with the General Storekeeper, is in possession at all times of the actual quantities of all the stocks on hand.

During the season of 1915, considerable economies were the result of the efficient administration of this Department, contracts having been made early in the spring, when prices were very much lower than they are at present, to cover the season's requirements.

PAYMASTER'S DEPARTMENT.

The following statement of the wages and salaries paid by this department, yearly, for the past decade, demonstrates, without further comment, the benefits derived by labor from the works carried out by the Commissioners in the development of the facilities of the Port.

1906.....	\$286,000.00
1907.....	371,904.64
1908.....	411,674.87
1909.....	327,889.18
1910.....	698,805.03
1911.....	1,123,196.05
1912.....	1,343,801.09

1913.....	1,302,100.53
1914.....	1,299,336.66
1915.....	1,024,300.45

It is a pleasure to record the successful working of this Department under Mr. Robert A. Eakin, Paymaster.

RAILWAY TRAFFIC DEPARTMENT.

Winter Operations.

During the close of the season of 1915, for the first time since 1908 when operations during the winter were begun, none of the Harbour Sheds were occupied by the railway companies as freight sheds, this business, in former years, having been the principal work of the Department. This loss of traffic, however, was adequately



Sheds Nos. 24 and 25 and Harbour Railway Terminals, just completed

replaced by the car handling to and from Sheds 16, 24 and 25, which were used for the compressing of hay.

The usual local traffic and through traffic were also handled.

Traffic returns during the winter, in comparison with last year, show an increase of more than 25%.

Car Handling.

Although tugs were navigating in the basins in the early part of April, it was not until the last days of the month that railway traffic commenced to arrive for steamers, the first of which berthed on April 30th, on which date was begun the most successful season in the history of the Railway Traffic Department.

While the month of May did not show an increase over the corresponding month of the previous year, every succeeding month of the season gave considerably augmented returns, September, October and November attaining an aggregate of 63,573 cars, inwards and outwards, making an average handling of 705 cars every 24 hours.

The total handling during the year amounted to 157,480 cars, an increase of 43,031 cars over the year 1914.

The nature of the traffic handled was much the same as last year, subsequent to August 1st, consisting of stores, munitions, horses, provisions, etc., for the British and Allied Governments.

A new line of traffic was, however, developed in the handling of bagged grain in cars from Elevator No. 2 to the various berths in the harbour, over 1,000 cars being so transported during the season.



Bagging Grain, Elevator No. 2. Teaming to Sheds

Passenger Traffic.

The passenger traffic, inaugurated last year in connection with the mobilization of the Canadian Contingents, for steamers sailing from this port, and for through transfer from the west end to the east end railway terminals, was kept up continuously during the season and handled in a most expeditious and satisfactory manner, no delays or mishaps whatever having been recorded.

Perishable Cargo.

It is also a matter of gratification to record the great increase in shipments of chilled meats in cars during the season. This traffic, being of a perishable nature, requires special attention and it is quite within the realm of possibilities that owing to the efficient service it received on these terminals, expressions of which were made by the representatives of the shippers at different occasions, a large part of this trade may be retained for the port.

Traffic at Sheds.

Notwithstanding the decrease in import freight, the car handling at the sheds is nearly twice as large as last year, 43,096 cars being the total number loaded direct to and from the sheds.

New Traffic Dept. Accommodation.

New quarters were provided for the outside staff of the Traffic Department by the erection at Section 19 of a building, two stories in height, the upper floor being occupied by the General Yardmaster, his assistants and clerks, and the lower floor by the trainmen and engine-men.

As the new building is centrally situated with regard to the operations of the Department, it has been found far more advantageous than the old location at Section 15.

Locomotive Repairs, etc.

All repairs to the locomotives, cars and plant in general were carried out in the Harbour shops with efficiency. To the repairs were added, this year, the erecting of one of the heaviest engines, which, on account of its small capacity for coal and water, was changed from the tank type engine to a tender engine. The work entailed, excepting the construction of the trucks, was done by the Departmental staff. This change has been found necessary owing to the constantly growing track mileage operated, which has increased from 20 miles in 1908 to more than 45 miles of track at the close of 1915.

Extension of Railway Embankment.

The extension of the railway embankment, eastwards from section 62, was proceeded with during the summer,

and the railway tracks have now reached section 71, Vulcan Wharf, connecting there with the tracks of the Canada Cement Company, leading to their Vulcan Mill.

When shipments are resumed by rail from this mill, a large amount of traffic for transfer to the railway terminals and for local delivery on the wharf is anticipated.

What such extensions of the Harbour railway mean is just about being realized from an industrial standpoint. Industries, located along the railway, where land is cheap, enjoy the convenience of having direct connection with every avenue of transportation, are in an enviable position as far as despatch and low charges are concerned, and are capable of the same development as those located on the river front, opposite the heart of the city.

While some benefit is derived by the community from the transshipment of cargoes arriving in Montreal, destined to points beyond, such a commercial operation is not so remunerative as the class of merchandise imported for the purpose of manufacturing. The port profits most when the merchandise is imported and with the least expenditure of energy and money transformed into manufactured articles for further sale and shipment. In order to assist in a reduction of the handling and distributing charges of the Port, the Commissioners have constructed spurs from the Harbour railway into most of the plants adjoining the Harbour. They realize that the greatest efficiency in industry can be obtained when the factories are located close to the railroads and to the ships in the Harbour.

Growth of Railway Department.

From the following statement, showing the number of cars handled yearly since the Department was organized in 1907, it will be observed that the growth of railway traffic in



Shipping Bagged Wheat by Railway Cars from Elevator No. 2

this Port is continual, and while the conditions which account for the most successful season just brought to a close may have been unusual, the Commissioners feel that they can confidently look for a continuance of increased railway business.

1907.....	70,856
1908.....	60,266
1909.....	75,636
1910.....	79,466
1911.....	93,859
1912.....	112,911
1913.....	114,531
1914.....	114,449
1915.....	157,480

During the busiest period this season it has been necessary to exert all energies to prevent congestion of

these terminals, and as prompt and economical operations depend upon the facilities at our disposal for taking care of all railway business, a comprehensive plan of additional railway facilities requires immediate consideration.

It is pleasing to record operations on such a large scale throughout the season without any serious delays and only a few inconsequential accidents.

ELECTRIFICATION OF HARBOUR RAILWAY TERMINALS.

The increase in the railway traffic of the Port and the mileage of trackage in operation makes it important to proceed with the utmost despatch in establishing facilities which will not only retain Canadian trade, but which, by their superiority over those provided at competitive ports, will attract additional business.

With this object in view, the Commissioners have, during the past year, devoted much time and thought to a study of a scheme for the complete electrification of the harbour railway terminals, visiting and inspecting in the meantime the electric freight terminals of the New York Central, Pennsylvania and New York, New Haven & Hartford Railroads at New York, Oak Point, New Rochelle, etc., where the application of electricity had proved successful in the movement of freight at the various terminals.

It was also ascertained that, in addition to the primary object of overcoming the smoke nuisance, the application of electricity had proved that it had, among many other, the following advantages over steam for railroad terminal traction:—

Economy in operation and maintenance; flexibility of control; availability for immediate service; fewer units

required for equal service; elimination of corrosion of steel and galvanized iron by acid gases; fire danger reduced; and standby losses much lowered.

As a result of this investigation, an expert electrical engineer has, for some time past, been engaged in studying on the ground the railway conditions of the Port and preparing a report as to designs, types and estimates, upon receipt of which it is proposed, should the report confirm the conclusions arrived at by the Commissioners, to proceed at once with the work of completely electrifying the Montreal Harbour terminals, upon the consummation of which Montreal will have the distinction of being the first Port in the world possessing a complete system of electrified freight terminals.

PERMANENT WAREHOUSES.

On many occasions, representatives of foreign shippers of manufactured goods, raw materials and unmanufactured products have called attention to the Port of Montreal as being behind other great importing ports in the matter of warehouses. Agencies controlling these products complain that they are at a disadvantage in not being able to hold stocks in Montreal for shipment to different parts of Canada as required, particularly in carload lots. Their reason is that in the Port of Montreal there is no warehouse situated on the wharves to receive goods during the summer season, when freights are advantageous, and hold them so as to make speedy delivery when required. New York has great advantages over Montreal in the large ocean terminal warehouses, which have been such a noted success.

Montreal wholesale merchants and local importers also have frequently asked for storage space for their goods.

It is probable that the reason for this lack of wharf warehousing accommodation is due to the fact that in the past Montreal Harbour was closed in the winter, not only to steamships, but also to railway and cartage traffic. With the introduction of the high level system of railways and roadways, this is no longer a physical objection, and the Harbour is an excellent situation, not only economically, but for railway business and for local cartage, owing to its central situation.

The Commissioners have had under consideration plans for an eight-storey warehouse, to be situated in a central position on the Harbour. The warehouse would have all the advantages of modern design. A railway car elevator hoist would take cars to the unloading platforms at each floor. The Harbour Commissioners would undertake to handle freight by railway car from the sheds to the warehouse, or vice-versa. Cars for delivery to outside points could be loaded at the different floors and shipped without any intermediary cartage.

It is expected that this warehouse will be commenced in a very short time, and intended occupants are invited to correspond with the Harbour Commissioners as to facilities which they may particularly desire to have installed.

The Port of Manchester warehouses have borne out every anticipation, so much so that the Port of New Orleans has already undertaken similar developments. In addition to the magnificent warehouses which have made the Port of Manchester famous, in June of this year the Trafford Park Estates Company built a 15,000-ton warehouse in six weeks to enable them to assist one of the Government Departments to house a large quantity of produce, for which they had no other suitable accom-



One of the Harbour Transit sheds—upper storey

modation anywhere in the country. The company had done more to relieve congestion at the ports—principally of London and Liverpool—than had the action of any Government Department or Committee. They offered the Sugar Commission storage for a cargo which had already been lying for a considerable time in the Thames awaiting a discharging berth. Later they took a cargo which had been lying in Liverpool awaiting a berth, and, as a result of providing the facility, cargoes of refined sugar were being regularly consigned direct to Manchester, which had thus become an important distributing centre for refined sugar. They gave direct assistance to the War Office by storing for them a reserve stock of flour of more than 20,000 tons. They anticipated a great increase of trade to the port in consequence of the new storage facilities.

HARBOUR BOUNDARY.

Owing to the death of Mr. Joseph Rielle, Q.L.S., for many years the Commissioners' Land Surveyor, the work of completing the proces-verbaux defining and determining the boundary line between the Harbour property and that of the adjoining proprietors—in that portion of the Harbour extending from Longue Pointe Church to Bout del'Isle—was intrusted to Mr. Malcolm D. Barclay, P.L.S., who had acquired possession of the records belonging to his predecessor.

EXTENSION TO HARBOUR YARD.

In 1911, the Harbour Yard on Papineau Avenue, where large quantities of stores were kept, proving too small for requirements as well as inconvenient because of its isolation and distance from the works, a new yard adjoining the Harbour was purchased on Notre Dame St. East, having a frontage of 385 feet.

New reinforced concrete carpenter and blacksmiths' shops, machine shops, storehouses and offices, as well as locomotive house and repairing plant, were subsequently erected on the site, which is connected by rail with all parts of the river front.

The accommodation provided by these buildings having, even within such a short time, been found inadequate, owing to the growth of Harbour work and the large amount of stock requiring to be there stored, the Commissioners early in the year acquired the parcel of land to the immediate east of the present yard, having a frontage of 111 feet on Notre Dame Street, and an area of 18,390 sq. ft.

Plans are at present being prepared for the erection of

further warehouse accommodation on the property which will permit of the Commissioners concentrating at this depot the main supply of stores under their General Store-keeper.

GOVERNMENT FARM, LONGUEUIL.

In 1913, by order in Council the Commissioners were given a lease for 99 years of a portion of the above property to be used for harbour purposes when facilities are required on the South Shore to take care of the large industrial development expected in that vicinity.

During the past season exemptions from municipal and school taxes of any kind were granted during the continuance of the lease.

ENTERTAINMENT OF DISTINGUISHED VISITORS.

During the year the Commissioners were honoured with a visit from, among others, the following distinguished gentlemen, all of whom were much impressed, after being shown over the Harbour, with the magnitude of the work entailed in the building of a great Port, and of the vital importance of the Port's efficiency to the business of the country :—

Mr. Akira Yamauchi, Councillor of the Department of Agriculture and Commerce, Japan; March 19th.

Mayors of Canada; May 27th.

Mr. Maurice Williams, of the State Engineer and Surveyor's Office, Albany, N.Y.; June 29th.

Members of the Builders' Exchange; July 12th.

Convention of Knights Templars; August 12th.

Mr. D. A. Thomas, Representative of the British Government, on a trip to America in connection with

manufacture and shipment of war munitions; August 28th.

Mr. Stanley W. Porter, M.I.M.E., England, October 12th; and Mr. Thos. B. Hughes, of Melbourne, Australia, October 13th, for inspection of Harbour Commissioners' grain handling facilities.

Dr. Allesandro Morro, Venice, Italy, for inspection of grain handling facilities; October 26th.

M. Claude Rigaud, of the Gouvernement General de l'Indo-Chine francaise; October 29th.

Mr. Jerome Newman, Chief Engineer, San Francisco Harbour Commission; November 1st.

Mr. J. Sandeman Allen, of London and Liverpool, Eng.; November 22nd.

The Terminal Commission of the Commonwealth of Massachusetts; December 9th.

Chicago Harbour and Subway Commission; December 20th.

CONFERENCE OF PORT AUTHORITIES.

The name of the National Association of Port Authorities of the United States having been changed at the Convention of that body held in Baltimore in September, 1914, to that of the American Association of Port Authorities, in order to admit of membership of those engaged in Harbour work in Canada, Mexico and South America, the Harbour Commissioners of Montreal were subsequently elected members of the Association, which has for its objects the exchange of information relative to port construction and maintenance, operation, organization, administration and management, the formulation of recommendations for the standardization of port facilities and the encouragement of water borne commerce.

Accordingly, early in September, President W. G. Ross, Commissioner Brig.-Gen. A. E. Labelle, and Assistant-Secretary M. P. Fennell, Jr., proceeded by way of the Canadian Pacific Railway and Vancouver to Los Angeles, Cal., where, on the 13th, 14th and 15th of September, they attended, with representatives of the leading seaports of North America, the 4th Convention of the Association.

Some valuable data was gleaned from the papers presented with regard to the different phases of port development, and the systems employed at various ports, and the Commissioners were much gratified with the unanimous expression of opinion from the leading harbour authorities of the Continent that the Port of Montreal afforded one of the best examples of modern seaport organization, possessing unity of control, opportunity for expansion, adequate articulation of land and water factors and co-ordination of their uses under intelligent supervision.

At the conclusion of the three days' session, which provided excellent opportunities for stimulating interchange of ideas, etc., the Harbour Commissioners were singularly honoured by having the President, W. G. Ross, elected first Vice-President of the Association, and the Port of Montreal chosen as the meeting place for the Convention to be held in 1916.

Subsequently, on the 20th and 21st September, the Commissioners also attended at San Francisco the 2nd Annual Convention of the Pacific Coast Port Authorities, where an opportunity was furnished of becoming acquainted with the different Harbour Authorities on the coast from Prince Rupert to San Diego.

In view of the large sums of money being expended in port developments from Alaska to lower California to provide for the increase in traffic that is expected to result from the opening of the Panama Canal which Port Commissioner Gen. Chittenden, of Seattle, has stated "means a new lease of life to the Pacific Coast through the elimination of those barriers which separate it from its true source of sustenance and growth," the Commissioners availed themselves of the opportunity of being on the Coast and made a thorough inspection and study on the spot of the administration and constructional methods employed at the following ports :—

San Diego, Cal.	Seattle, Wash.
Los Angeles, Cal.	Tacoma, Wash.
San Francisco, Cal.	Victoria, B.C.
Astoria, Oregon.	Esquimalt, B.C.
Portland, Oregon.	Vancouver, B.C.
Prince Rupert, B.C.	

A mass of valuable information was collected and submitted in the form of a report, part of which is appended to this Report, and a book containing the charts of the harbours above enumerated, and construction plans and details, now forms a valuable addition to the Commissioners' library.

WAR ROLL OF HONOUR.

Since the war was declared, the Commissioners have encouraged the enlistment of their staff by giving half pay to every officer and workman who enlisted for Overseas Service.

In addition to the following on active service many employees are also serving their country on home service.

Capt. J. F. Symons, R.N.R.	P. Doyle.
Sergt.-Major W. J. Porteous	J. Furlong.
P. F. C. Roberts.	A. Clark.
J. W. Creighton,	W. Draper.
Lieut. K. L. Duggan.	J. W. Sephton.
G. O. Thom.	R. H. Dawes.
A. P. Sibley.	J. Waine.
Geo. McCart.	P. Fitzpatrick.
D. McQuirk.	T. J. Lily.
F. Jones.	D. Verville.
E. Mockridge.	W. Waldorf.
J. Querel.	J. Milan.
V. Flipping.	T. Stewart.
R. Pauman.	H. Byers.
J. Fisher.	J. Morrison.
W. Chapman.	E. Bedard.
N. Marion.	

In the matter of employment of workmen, the Commissioners have adopted the rule that whenever possible, soldiers who return from the front will be engaged in preference to all others.

During the season space in the Wharf Sheds was gratuitously granted for the assembling of all donations received for the soldiers at the front, pending shipment.

No charges were imposed on supplies handled throughout the year for the Belgian Relief Committee and the Red Cross Societies.

MONTREAL WATER LEVEL COMMISSION.

By Order-in-Council, dated 12th June, 1915, a Board of Commissioners, composed of Mr. Eugene Haskell, Dean of the College of Civil Engineering, Cornell University ;

Mr. W. J. Stewart, Hydrographer, Department of the Naval Service ; and Mr. Frederick Wm. Cowie, Chief Engineer, Harbour Commissioners of Montreal, was appointed to make a thorough examination and report upon the following matters relating to the Harbour of Montreal, with suggestions for any necessary remedies that it deems advisable, viz. :—

Effect of past dredging in the ship channel.

Effect of past dredging in St. Mary's Current.

Effect of all dredging in the St. Lawrence River on the water levels of the Harbour.

Probable effect of the dredging now being conducted south of St. Helen's Island.

Probable effect of other proposed dredging in Montreal Harbour.

Probable effect of any extension of the Guard Pier.

Probable effect of any increased diversion of water from the valley of the St. Lawrence and Great Lakes.

Probable effect of storage dams in the Ottawa River.

If deemed advisable, the Board may make suggestions to ameliorate trouble from ice.

The Water Level Commissioners met on June 28th, and the Harbour Commissioners gave the necessary accommodation for the Water Level Board in the Harbour Building, and after a complete discussion and a thorough inspection of the Harbour from all points of vantage, the Water Level Commissioners reported that in view of the importance of the physical features of the Harbour of Montreal with reference to navigation and future developments, a thorough and independent in-

vestigation should be made so that a final authoritative pronouncement could be given. With the approval of the Department of Marine and Fisheries a staff was organized to make investigations, complete plans and records, and to report not later than 30th March, 1917. Mr. A. J. Matheson was appointed Engineer of the Commission, and investigations are now in progress. The Commissioners have met every two weeks, and it is expected that the appointment of this Commission will give valuable results.

FINANCIAL STATEMENT.

The Statement of Receipts and Disbursements for the year 1915, hereto annexed, shows receipts on Revenue Account of \$1,348,241.65, a decrease of \$118,122.62 from the previous year, due principally to less grain being handled and the falling off in wharfages on imports.

The cost of operation, maintenance, interest, etc., was \$1,436,533.85, a decrease from the previous year of \$22,921.23. The interest charges, which were \$835,712.03, show an increase of \$50,179.06 on new loans, due to the continued carrying out of works of improvement, the total expenditure including interest chargeable to revenue exceeding the receipts.

There was received from the Dominion Government on loan \$1,955,081.69, of which \$1,755,081.69 was on account of capital expenditure on works of improvement, and \$200,000.00 to retire Debentures held by the public.

The Disbursements on Capital Account were \$1,850,001.40 on the following works of improvement:—

HARBOUR COMMISSIONERS OF MONTREAL.

Statement of Receipts and Disbursements for the Year ended 31st December, 1915.

ITEMS	TOTALS	GRAND TOTALS	ITEMS	TOTALS	GRAND TOTALS
RECEIPTS ON REVENUE ACCOUNT.					
Grain Elevator System.....	\$390,079.29		Grain Elevator System, Operation and Maintenance.....	\$220,416.97	
Railway Traffic Department.....	252,287.75		Railway Traffic, Operation and Maintenance.....	194,679.65	
Wharfage Rates.....	386,048.21		Harbour Equipment, Operation and Maintenance.....	49,649.80	
Rental of Sheds, Hoists, etc.....	202,604.82		(The above do not cover Interest, Depreciation, Administration, etc.)		
Rentals of Harbour Spaces.....	108,179.50		Miscellaneous and General Expenses.....	92,667.52	
Sundry Receipts on Revenue Account.....	9,042.08		Police Service on Wharves.....	27,400.75	
Total Receipts on Revenue Account.....		\$1,348,241.65	War Service Allowance and Patriotic Fund.....	9,100.52	
			Sundry Disbursements on Revenue Account.....	6,947.61	
RECEIPTS ON CAPITAL ACCOUNT					
Dominion Government Advances under Act 1, Edward VII, Cap. 9.....	32,500.00		Total Operation and Maintenance.....	600,821.82	
Act 2, George V, Cap. 36.....	1,135,500.00		Interest on Debentures and Loans from Bank.....	835,712.03	
Act 4-5, George V, Cap. 41.....	787,081.69		Total Disbursements on Revenue Account.....		\$1,436,533.85
Total Advances by Government in 1915.....	1,955,081.69				
Security Deposits received from Contractors.....	11,906.00		DISBURSEMENTS ON CAPITAL ACCOUNT		
Grand Total Receipts.....	3,315,229.34		Grain Elevator No. 2.....	\$133,466.48	
Loans from Bank of Montreal as at 31st December, 1915.....	339,591.16		Grain Elevator No.1 Addition, West Extension.....	482,079.88	
Less:			Grain Elevator No.1 Addition, East Extension.....	21,404.29	
Loans 31st December, 1914.....	305,771.15		Grain Elevators Total.....	\$636,950.65	
Balance of Loans, to add.....		33,820.01	Victoria Pier and Market Basin Wharves.....	156,536.69	
(The above loans are on account of Capital Expenditure in 1915, to cover which advances have been applied for from the Dominion Government, but not received in 1915).			High Level Wharves, Sections 25 to 30.....	125,316.52	
Outstanding Accounts and Accrued Interest as at 31st December, 1915.....	600,706.08		Floating Dock Site and Basin.....	3,316.52	
Less:			Pointe aux Trembles Wharf, Sec. 96 and 97.....	16,503.04	
Outstanding Accounts and Interest, 1914.....	592,235.42		Pointe aux Trembles Wharf, Sec. 100 and 101.....	76,707.16	
Balance of Outstanding, to add.....		8,470.66	Windmill Point Wharf and Basin.....	42,621.85	
			Bicêtre Pier, Widening.....	62,383.22	
			Bicêtre Pier, New Approach South.....	4,400.00	
			Paving Wharves and Piers.....	4,640.93	
			Harbour Boundaries.....	4,620.00	
			New Water Pipes and Drains.....	757.57	
			St. Helen's Island Wharf, Balance.....	346.78	
			Wharves, Piers and Basins, Total.....	565,683.72	
			Channel South of St. Helens Island.....	204,924.83	
			Widening between Ile Verte & Mackay Pier.....	33,546.26	
			Dredging Inside Mackay Pier.....	29,926.16	
			Altering Lower End of Mackay Pier.....	1,017.07	
			Moffat's Island Wharf Removal, Balance.....	290.16	
			Harbour Dredging, Total.....	269,704.48	
			Real Estate, Hochelaga, Mill St., & Montreal South.....	158,636.07	
			Harbour Railway, Tracks and Sidings.....	145,068.93	
			New Plant, Derrick, Tug, Scows, etc.....	37,268.77	
			Permanent Sheds, Sec. 20, 24 and 25, & Tarte Pier.....	29,453.93	
			Electric Hoist Shed 24 and Electric Circuit.....	6,941.45	
			Total Disbursements on Capital Account.....		1,850,001.40
			Debentures Retired, Series D, due 5th July, 1915.....	100,000.00	
			Series E, due 5th July, 1915.....	100,000.00	
			Total Debentures Retired.....		200,000.00
			Security Deposits returned to Contractors.....		18,132.25
			Grand Total Disbursements.....		\$3,504,667.50
			Less:		
			Received from Dominion Government for Interest on Capital Expenditure during Construction previous to 1915.....		232,081.69
			Add:		
			Balance at 31st December, 1915:—		\$3,272,585.81
			Cash on Hand.....		
			Bank of Montreal, Coupon Account Balance.....	4,000.00	
			Accounts Receivable and in suspense.....	460.00	
			Materials in Stock at 31st December, 1915.....	275,613.62	
			Total Balance at 31st December, 1915.....	361,137.21	
			Less:		
			Balance at 31st December, 1914.....	641,210.83	
			Difference in Balance, to add.....	556,276.63	
					84,934.20
					\$3,357,520.01

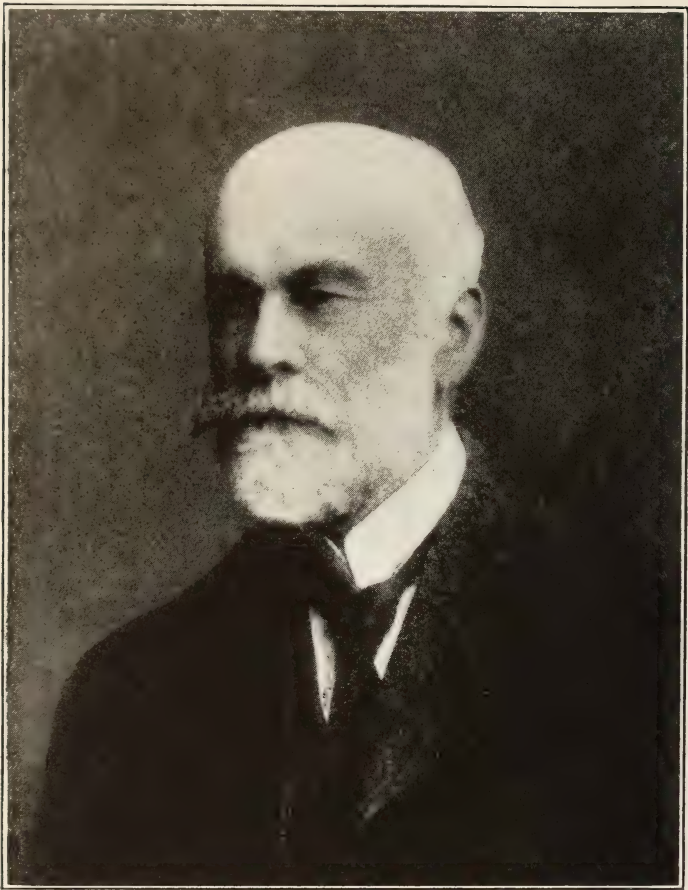
Verified:
GEORGE E. SMART, Comptroller.
MONTREAL, January 15th, 1916.

Verified:
RIDDELL, STEAD, GRAHAM & HUTCHISON, C.A., Auditors.

Certified:
DAVID SEATH, Secretary-Treasurer.

Grain Elevators.....	\$636,950.65
Wharves, Piers and Basins.....	565,683.72
Harbour Dredging.....	269,704.48
Real Estate.....	158,636.07
Harbour Railway.....	145,065.93
New Plant.....	37,265.17
Permanent Sheds and Hoists.....	36,695.38
	<hr/>
	\$1,850,001.40

The Debenture Debt of the Corporation on the 31st December, 1915, was \$25,309,081.69, of which \$24,-037,081.69 is due to the Government and \$1,272,000.00 to the public.



SIR JOHN KENNEDY

Who has for the past 41 years been connected with the development of Canada's National Port, having served in the capacity of Chief Engineer from 1875 to 1907, and as Consulting Engineer since that time.

SIR JOHN KENNEDY.

It is with great pleasure that the Commissioners record the conferring on New Year's Day, 1916, by His Majesty King George V, of the honour of Knight Bachelor on their Consulting Engineer, John Kennedy, and as this is the beginning of the 42nd year of his continuous service under the Harbour Commission, a brief sketch of his administration as Chief Engineer and of the most important works carried out by him in connection with the River St. Lawrence Ship Channel and the Harbour of Montreal is appropriate.

The deepening of the Ship Channel between Montreal and Quebec from 16½ ft. to 20 ft. was completed at the end of 1865, and was followed by the immediate increase of the ocean tonnage of the Port of Montreal from 153,000 tons net register in 1865 to 205,000 tons in 1866; in 1870 it had risen to 317,000 tons, and by 1874 to 412,000 tons.

In 1870 the tonnage was composed of nearly 60% sailing vessels and 40% steamers, but by 1873 the proportions had been reversed. The rapid increase of trade and of the size of the vessels made it necessary that the ship channel be again deepened, and that the Harbour facilities be greatly enlarged and improved.

The deepening of the channel to 24 feet was therefore determined upon, and the necessary legislation obtained. The building of four dipper dredges for Harbour enlargement and of six elevator dredges for ship channel deepening was undertaken, and contracts were entered into for building a considerable extent of shallow water wharfage along the city shore of the St. Mary's Current, and of some deep water wharfage at Hochelaga. The management of the ship channel deepening and of the Harbour enlargement work was put into the hands of John Kennedy,

as Chief Engineer, who resigned his position as Chief Engineer of the Great Western Railway System, then the most important in Canada, to enter upon his new duties on May 1st, 1875.

Mr. Kennedy, who, in addition to having a large and varied experience in civil and mechanical engineering, already had a knowledge of the ship channel and Harbour works, having been an assistant to the eminent engineer, the late Thos. C. Keefer, while engineer of those works, and also to his successor, the late Robert Forsyth.

It had been the practice of the Harbour Commissioners in all previous deepenings of the ship channel to carry out the work with their own dredging plant and staff of officers and men, and the system was continued with success.

In dredging the channel to 24 feet, it was feasible to do so either by dredging over the whole channel in two cuts of two feet depth each, or to make the whole increase in one cut of four feet, the time of completing the whole being about the same in each case, but with the important difference that in deepening by two cuts navigation would have the benefit of one half the increase of depth in half the time, and the invested capital would begin to yield return in useful service so much the sooner, but with the disadvantage that the capital cost under the two-cut system would be somewhat more than under the one-cut system.

Mr. Kennedy advised deepening by two cuts, with its earlier usefulness, as being altogether the most advantageous to the shipping trade of the Harbour, and, with the approval of the Commissioners, that policy was adopted for that and all subsequent deepenings of the ship channel carried out by the Harbour Commissioners.

The first stage of the deepening to 22 feet was accomplished by the close of navigation in 1878. The next stage, by which time it had been determined to make the channel 25 feet deep instead of 24 feet, was completed in 1882, and an additional deepening to $27\frac{1}{2}$ feet was immediately undertaken and was completed by the end of 1888. To this stage the interest of the entire capital cost of the work had been paid out of the Montreal Harbour revenues, but it was realized that this was not only an unduly heavy burden upon the trade of Montreal but, to a considerable extent, upon the trade of the Dominion as well, and for that and other reasons the ship channel should be classed with the canals and other works for the improvement of navigation, and be taken in hand by the Government. This policy was adopted, and the ship channel debt, as also the ship channel itself, all the dredging plant and staff, were taken over by the Department of Public Works of the Dominion.

The ship channel was carried on for another year under the immediate management of the Harbour Commissioners' staff, but under the general direction and at the cost of the Department of Public Works, and at the close of the season the entire ship channel staff, except the Chief Engineer, Mr. Kennedy, was taken over by the Department.

In order that the contemplated Harbour enlargement should be carried out on a wise and comprehensive plan, a Board of Engineers, composed of Mr. Bruce Bell, an eminent engineer of Glasgow, General John Newton, of the U.S. Army Engineers, and Mr. Sanford Flemming, an eminent Canadian engineer, were called in to devise a scheme of Harbour improvement which could be carried out as required by the trade, and a plan, known as the

Bell, Newton and Flemming plan, was the result of their deliberations.

While the new plan was being devised, a period of commercial depression set in which postponed the need of any considerable enlargement in Harbour accommodation, and the plan was therefore left in abeyance.

In 1871 the Grand Trunk Railway had been permitted to lay a railway track on the wharf in the central part of the Harbour and to have exclusive use of it. On becoming Harbour engineer, Mr. Kennedy strongly advised the acquiring of the track by the Commissioners, and the cancelling of the exclusive privileges of the Grand Trunk, in order that tracks belonging to the Commissioners might be laid upon all the wharves, and that all railways should be allowed to connect with them, and in this way the Harbour should be made both a railway and ocean shipping terminal, affording the greatest possible facilities for the interchange of traffic between railways and ships, with the greatest economy and despatch in trans-shipping. The taking over of the Grand Trunk tracks by the Commissioners was agreed upon, and the policy of thus making the Harbour a double terminal has been carried out to an extent and with advantages which are the envy of all other ports not so favourably conditioned.

On the revival of trade, the Commissioners in 1888 instructed Mr. Kennedy to prepare a scheme of Harbour enlargement, which he did, and of which the main features were: a guard pier, consisting of a rock and earth embankment extending from the outer end of the abutment of the Victoria Bridge at Point St. Charles downstream towards St. Helen's Island, enclosing between the embankment and the shore a great basin of one and a half miles in length, protected from the ice-shoves in winter,

and from the swift currents in summer, and having a series of piers extending out from the shore wharves in the space between the entrance of the Lachine Canal and the Victoria Pier. The plan also included a series of piers extending out from the shore at Hochelaga, and a suggestion for improving and utilizing the large area enclosed between the Windmill Point wharves and the guard pier up to Victoria Bridge, as well as the extension of the Harbour railway tracks to all the wharves.

The flooding of the city by winter floods of unprecedented height in 1886 and 1887 led to the appointment by the Government of a Royal Commission of Engineers, consisting of Thos. C. Keefer, C.M.G., Consulting Engineer, Henry F. Perley, Chief Engineer of Public Works, P. W. St. George, City Engineer, and John Kennedy, Harbour Engineer, who, after a thorough investigation of the causes of the formation and accumulation of frazil, causes and action of ice-shoves, the breaking up of ice fields, and jams by steamers and explosives, submitted plans for protecting the city from floods, the main features of which were: dykes along the low level parts of the city front, the closing of sewers which discharged below flood water level during flood time, the pumping of sewage to discharge above flood level, and the fitting in of the whole with the plan of Harbour improvement which had been prepared by Mr. Kennedy.

The recommendations of the Flood Commissioners were promptly adopted by the City Council and the Harbour Commissioners. A temporary dyke of earth and timber was built along the river side of Commissioners Street throughout the low level part between the east end of Bonsecours Market and the Lachine Canal bank near Black's Bridge. A permanent earth bank was also built

from the south side of Lachine Canal along the shore line at Point St. Charles to the Montreal Water Works tail-race, and thence along the northeastern side of the tail-race to above flood level near the Lachine Canal, and sewer gates and sewage apparatus were also installed. By these works, and by the substitution of a permanent masonry wall for the temporary dyke, along Common and Commissioners Streets, the City has ever since been successfully protected from the flooding caused by the ice jams in the river.

The carrying out of the permanent flood protection works, as distinguished from the temporary works hurriedly constructed in 1887, the widening of Commissioners and Common Streets, and the carrying out of the proposed Harbour Enlargement Works, were carefully considered in conferences between Mr. P. W. St. George, City Surveyor, and Mr. John Kennedy, Harbour Commissioners' Engineer, which resulted in the preparation of a plan known as "No. 6."

The controversy which had arisen as to the extent of the new wharfrage which should be provided between the Lachine Canal and the Victoria Pier, was terminated by the late Hon. J. Israel Tarte, Minister of Public Works, who insisted as a condition of his approval of the plans that the number of piers be reduced to three instead of four, and that their length be reduced to a maximum of 1,000 feet instead of 1,300 feet. The change was agreed to by the Harbour Commissioners, and the carrying out of the plan as thus altered was sanctioned by Government.

The adoption of the new plan of Harbour improvements with high level wharves in which there was a great increase in the surface of the quay wall above low water level, the increasing cost of timber, and its decreasing

durability above water level because of the poor kind available for wharf work, led Mr. Kennedy to recommend the substitution of concrete face walls for the timber cribwork from the low water line up, and the recommendation was accepted by the Commissioners for all wharves subsequently built, except for the three new piers. The construction of all the works embraced in the scheme of Harbour Enlargement and Flood Protection of the City were carried out with the Commissioners' own plant and working forces, with the exception of the building of the steamship sheds and grain elevators, which were done under contract. The work was prosecuted in such a way as to not seriously discommode the traffic in the Harbour and not at all to lessen it.

The enlargement work was commenced in 1890. By the end of 1906 and by the end of Mr. Kennedy's active administration at the end of January, 1907, the Guard Pier (Mackay Pier), had been built, Windmill Point Basin had been dredged out of the rock, its surrounding wharves between the entrance to the Lachine Canal and the Victoria Pier had all been constructed, most of the fourteen steamship sheds, Grain Elevator No. 1, and the Grain Conveyor System had been built, and the flood protection wall finished; a considerable extent of wharves between the lower end of the Victoria Pier and Section 28 had been widened and deepened, two of the three large piers at Hochelaga had been built by the Commissioners, and the remaining one by the Department of Public Works. The shore wharf at Section 62, opposite the lower water works, had been built, and the Harbour railway tracks had been extended so as to serve all shore wharves and piers except Victoria Pier.

In 1899, Mr. Kennedy's eyes became affected by an

incurable ailment, and by the beginning of 1907 his sight was so far gone that he resigned his position as Chief Engineer, upon which the Commissioners appointed him their Consulting Engineer, which position he still holds.

As Consulting Engineer, Sir John's services have been of the greatest value to the Commissioners, and it is hoped that they may prove of still greater assistance to the Port and to the country in the future.

ENGINEERING DEPARTMENT.

The Engineering Department of the Harbour Commissioners of Montreal is organized so as to have charge of varied and important branches, as follows :—

Harbour Construction, Maintenance and Operation.

The construction work, excepting buildings, is almost universally carried on departmentally. The steady growth of the Harbour and the constant yearly effort to keep pace with the commerce has resulted in the Commissioners having a splendid plant for the peculiar construction required. Dredging plant, tugs, derricks, and a shop for repairs, are all kept up-to-date, and the organization for construction is capable of dredging and placing in the works some two or three million cubic yards of excavated material; of building half-a-mile of cribwork and concrete quay walls of a height from the foundations to the cope of 60 feet; of building fifty thousand cubic yards of concrete, constructing railways, walls, sheds, culverts and, in fact, almost every phase of port construction.

HARBOUR CONSTRUCTION.

The following are the chief items of construction for the season :—

The improvement and extension of Harbour railway tracks.

The continuation of the construction of new Victoria Pier and Market Basin.

The continuation of the construction of bulkhead High Level wharves on the river front, eastwards from Victoria Pier.

General dredging for widening and deepening of basins and berths.

Dredging of channels for the amelioration of St. Mary's Current.

Paving and laying railway tracks on wharves.

The continuation to completion of improvements resulting in the Floating Dock Basin and site for the Canadian Vickers' ship-building and repair yard.

The construction and improvement of Harbour facilities, such as hoists, flood gates, bridges, subways and freight yards.

Additions and improvement to Harbour Commissioners' construction plant.

The re-building in concrete of the quay wall opposite Shed No. 13.

The construction of a second industrial wharf at Pointe-aux-Trembles.

The construction of the Longueuil-St. Lambert highway.

The commencement of the construction of the West Extension to Grain Elevator No. 1.

The diversion of the Elgin Basin sewer outlet and the moving of the Wharf Office building.

The acquisition of operating and railway plant.

The maintenance of berths and channels, of wharves, sheds, buildings, roadways, water service, cleaning of wharves and general repairs were carried on as usual.

The operating of Harbour facilities, such as plant for the storage and handling of grain, electric lighting and power services.

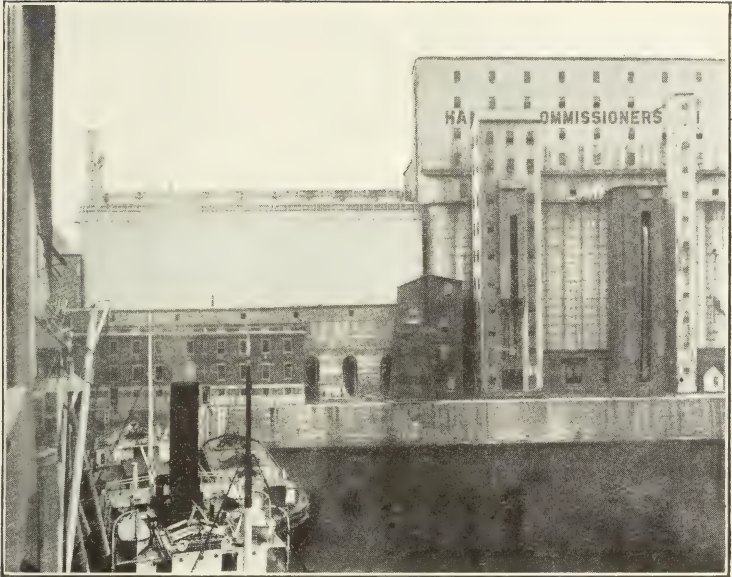
Operating the floating crane, electric hoists and the construction and maintenance of industrial connections with the Harbour were all carried on during the season with an even greater measure of success than usual.

CONSTRUCTION OF WEST EXTENSION ELEVATOR No. 1.

Prior to 1910, the export grain handling equipment in Montreal Harbour consisted of a 1,000,000 bushel elevator owned and operated by the Harbour Commissioners ; a 1,000,000 bushel elevator owned and operated by the Montreal Warehousing Company ; two obsolete wooden elevators owned by the Canadian Pacific Railway, since torn down ; and a fleet of floating transfer elevators of varying age and efficiency.

Early in 1910 the Harbour Commissioners of Montreal determined to erect a new grain elevator of the highest class and most modern type, to have a capacity of 1,772,000 bushels, and the construction of same was started. In 1911 it was found this extra storage room would still be insufficient to meet the needs of the Port, and an extension was authorized and construction started. The entire plant, known as Elevator No. 2, with a total capacity of 2,622,000 bushels, was put in operation in 1912.

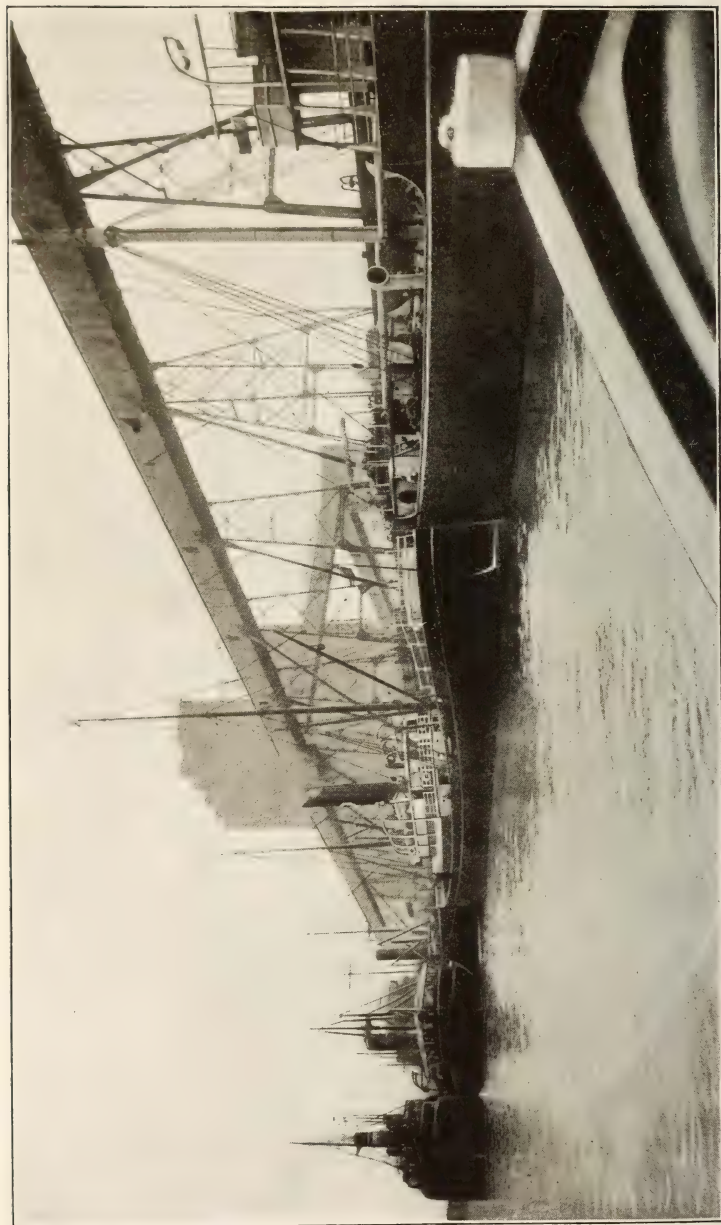
The grain business of the Port so increased as a direct result of the additional handling equipment that the



Elevator No. 1—West Extension. Progress of Construction, October, 1915

Commissioners decided, after due consideration, to provide still more storage space, and to this end, in the spring of 1913, the construction of a 1,500,000-bushel addition to No. 1. Elevator (the original unit of the Harbour Commissioners' Grain Elevator System) was started, same being complete and in operation on the opening of navigation 1914.

The volume of grain business done in 1914, which proved to be the greatest in the history of the Port, made it very evident that there was still not enough elevator capacity to obviate congestion and delay to steamers, whereupon the Commissioners decided on the erection of still another addition to Elevator No. 1, this being known as the West Extension. Plans and specifications for same were prepared in 1914, and construction was started early in 1915, and it is expected to have it in operation on the



Ocean Grain Vessels Loading and Waiting for Bertha, Windmill Point

opening of navigation 1916, when the total capacity of the Port will be as follows :—

No. 1 Elevator.....4,000,000 bushels.

No. 2 Elevator.....2,622,000 bushels.

Grand Trunk Elevator.....2,150,000 bushels.

The following is a description of the important features of the work in connection with the West Extension to Elevator No. 1:—

The general dimensions are:—length, 194 ft.; width, 127 ft.; height, 202 ft. above base of rail. There are 51 circular bins, approximately 22 ft. in diameter, and 62 interspace bins.

The foundations are of reinforced concrete on concrete piles. The structure to the top of bins is of reinforced concrete, and consists of about 15,000 cubic yards of concrete material. The cupola is of structural steel columns and beams, with reinforced concrete floors and roofs. The sides of the cupola are covered with corrugated galvanized steel.

The excavation for foundations was commenced in February, 1915; the pile driving was started in May. The driving was difficult, due to the hardness of the ground, and this work was not completed until the first part of September; 2,185 reinforced concrete piles, averaging over 30 feet in length, were driven. The general contractors on superstructure did not wait for the completion of the piling, but started their work in August, and made very good progress, and by the end of October had the building erected up to top of bins. During November and December the cupola steel was erected, a portion of the concrete roofs placed and a part of the cupola enclosed.

A large portion of the machinery has been manufactured, and a fair amount of spouting has been made.

On the completion of the West Extension, No. 1 Elevator will have the following equipment:—

Twelve elevator legs of 15,000 bushels capacity each per hour, each leg tributary to two garnerers.

Thirteen 1,600 bushel scales.

Three cupola transfer belts, extending the entire length of the building, 20,000 bushels capacity per hour each.

Three shipping belts in first storey, extending the length of the building.

Two marine towers with vessel unloading capacity of 20,000 bushels per hour each ; all of which means that:—

Grain can be received from lake vessels and barges at the rate of 40,000 bushels per hour.

Grain can be received from cars at the rate of 36 cars per hour.

Grain can be delivered to ocean vessels at the rate of 75,000 bushels per hour.

The bins are so arranged that 1,380,000 bushels storage space is tributary to shipping belts without re-elevating the grain.

In connection with the construction of the West Extension to Elevator No. 1, two items of work had to be carried out, viz.:—

1.—Removal of Wharf Office Building.

The fireproof, two-storey brick office building, which was in the way, was removed from its old foundations and placed on new concrete foundations resting on wooden piles alongside the water front 75 feet away. The building was raised about 3 ft. 4 ins., and a new solid stone



Elevator No. 1—West Extension. Removal of Wharf Office Building

wall was built for that height. The whole interior was repaired as far as plaster and paint is concerned, all windows facing the city were bricked up, and new terra-cotta furring blocks were laid. The old cellar, now the ground floor, has been altered for the use of the Police Staff, a concrete floor having been laid for same.

2.—Diversion of Elgin Basin Sewer.

This work was all but completed last year, when the rise of the river water put an end to operations on Dec. 15th, before a junction could be formed with the old sewer. The water being at an exceptionally low level this spring, it was possible to resume operations on April 16th, when the protective work was undone, the junction made and two timber bulkheads with puddle between constructed in the old sewer just beyond the point of junction. By direction of City officials, the grade of the floor of the old

sewer was adjusted to suit the elevation of the invert of the new sewer. When everything was completed except the refilling of the trench, the stop gates in Commissioners St., which were closed during the construction operations, were opened, and a test was made of the whole work, which gave entire satisfaction. The refilling was accordingly done, and the whole work completed on May 3rd.

HARBOUR RAILWAY TERMINALS.

The operation of the Railway Terminals has proved to be one of the most important and successful features of the development of the Harbour of Montreal.

On the north bank of the River St. Lawrence, adjoining the Cities of Montreal and Maisonneuve in their most congested industrial districts, from Victoria Bridge to Longue Pointe, the Harbour railway terminals extend.

The total distance, measured along the river bank, is 7 miles, but the total mileage of tracks is 44.9 miles.

The advantages of the railway connections of all trunk lines in Canada with all parts of the Harbour have long been appreciated. The full realization of this splendid connection between the Transcontinental Railways and the Transoceanic Ships is, however, only now becoming fully recognized. The new development, commenced in 1914, of the industrial business between the manufacturing establishments situated along the water front and the Canadian Railways, and also to and from the Harbour steamship berths, has shown remarkable advance in the season just closed.

The Harbour Commissioners have given instructions that every advantage is to be taken of the splendid location of the railways along the water front, with the idea of

connecting the industrial sidings with the Harbour railway tracks. Coal, raw materials, supplies and manufactured goods are shunted into the industries, while manufactured goods and completed articles are shipped out to all points of the country or to the steamships in the Harbour.

The rates charged by the Harbour Commissioners for this service are so moderate and the existing facilities and manner of operation give such good despatch that there is an immediate urgent demand by the new industries rapidly springing up along the water front for the prolongation of the Harbour terminals to new sites and to the industrial wharves specially being constructed.

Probably no feature of Harbour development will give such good results to the industrial growth of the city and at the same time to the success of the Harbour.

The Construction Department of the Harbour Commissioners, during the season of 1915, extended the river front embankment from the Racine Pier, Section 64, for a double track line, to the Vulcan Wharf, Section 71, and partially to Section 75, Longue Pointe.

The material forming this embankment is all spoil or waste material from Harbour and channel dredging.

The outside is protected by rip-rap, and concrete culverts are placed at frequent intervals to take care of the natural surface drainage and existing watercourses.

A single track railway now extends the whole distance to the Vulcan Wharf, and the necessary sidings and switches are being put in to handle the business.

In this work the quantity of material placed in the embankment was 198,000 cubic yards; about $1\frac{1}{4}$ miles of track was laid, and 500 lineal feet of 36-inch concrete culverts were constructed.

At Moreau Street a switching and city delivery yard was constructed, partially on Harbour property and partially on property acquired between the Harbour boundary and Notre Dame Street. Three additional tracks were laid, making a total length of three-quarters of a mile, and this industrial and distributing centre of the City, which petitioned for facilities, now has an excellent teaming terminal.

The new yard and subway to Aylwin Street was completed.

At Section 27, the high level railway embankment was widened and a third track laid for a length of one-quarter mile.

At the Tarte Pier, tracks were laid to meet the requirements of the Asphalt & Supply Co.'s new industry.

At Victoria Pier the two tracks were extended to an extent of one-half mile on the new wharf.

At Section 26, new double track railways, with the necessary crossovers, were completed on the new wharf for a length of one-half mile.

At the St. Lawrence Sugar Refineries, Section 44, new industrial sidings and connections were completed of a total length of one-third mile.

At Aylwin Street, a new track under the subway, connecting the Montreal Tramways Co. with the sand berth, was constructed.

At the Dry Dock site, additional tracks to the extent of one mile were laid on the area reclaimed this year, at the west end of the site.

At the new Cement Wharf, Pointe-aux-Trembles, railway tracks were laid to meet the requirements.

At Windmill Point, two new railway switching connections were put in to give special accommodation to the

industrial works of the Peck Rolling Mills and the Dominion Linseed Oil Co.'s plant.

The extent of the Harbour Commissioners' railway tracks at the end of 1915 is as follows :—

Total south-east of the Lachine Canal, operated by the Grand Trunk Railway, 7.14 miles. Total Harbour and industrial tracks, operated by the Commissioners, 37.17 miles. Other Harbour tracks, 0.61 mile. Grand total, 44.92 miles.

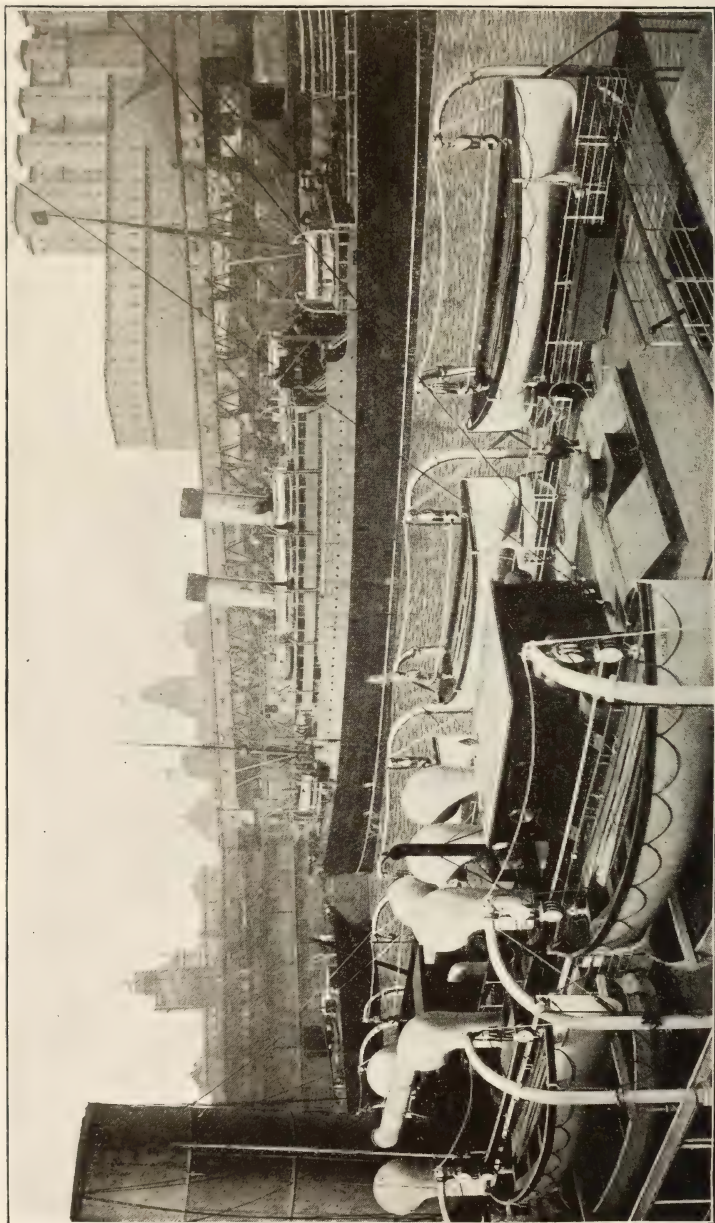
Total mileage of new track constructed in 1915, 5.5 miles. Total mileage of old tracks remodelled or removed, 1 mile.

At Section 12, opposite the Harbour Office, the throat of the Harbour Terminals, from the Grand Trunk Railway connection, was enlarged and remodelled to meet the urgent requirements. It was necessary to remove and reconstruct a length of 213 feet of the flood wall, to take up the pavement and concrete, and reconstruct the ladder track to meet the standards required for the operation of the heavy traffic and of the new business of passenger steamship special trains.

VICTORIA PIER AND MARKET BASIN.

In the scheme of Harbour extensions commenced in 1910, every consideration was given not only to the enlargement of steamship accommodation, but also to give additional and convenient accommodation to the important fleet of river and ferry steamers.

It was recognized that the river steamers, which do a tremendous passenger and market traffic, should have a location in the Harbour, convenient to the centre of the City and to the Bonsecours Market.



A View of one of Montreal Harbour Basins

The progress made towards the completion of the new Victoria Pier and Market Basin during the season was excellent. At the end of the last construction season, the outer quay wall was completed so as to give one excellent steamship berth. The inner low level quay wall of the Market Basin was also completed down to a sufficient distance to give several river steamer berths.

During 1915 the dredging was completed for the crib seats, and the last four cribs were sunk and the concrete quay walls connected up all around the lower end of the pier.

Construction work in this congested location at the entrance to both the central Harbour and the Market Basin was, as usual, continued with difficulty, but, by making better progress than expected, the contour of the finished pier was all completed before the severe weather closed down the work.

The outline of the lower end of the pier was slightly changed, after a study of the navigation conditions. The handling of vessels at the entrance of the Harbour was attended with much less difficulty than usual, owing to the advance in the dredging and the amelioration of the strength and direction of the currents.

The work for the season on this item may be summarized as follows :—

Cribs sunk, length on cope line, 645 feet.

Length of concrete quay wall, 645 feet.

Raising of low level quay wall to high level, 800 feet.

Low level slipways for river steamers, 9.

Extension of retaining wall, 128 feet.

The quantity of cribwork amounted to 722,000 cubic feet.

The quantity of mass concrete, 7,000 cubic yards.

The quantity of dredged material placed in the work, 172,000 cubic yards.

HIGH LEVEL SHORE WHARVES, SECTIONS 25 TO 30.

The old wharves, built many years ago from Papineau Avenue eastwards, and designed for small craft of the period, have been gradually giving way. The new Harbour designs called for the bulkhead quay walls being extended further out into the Harbour so as to give a minimum Harbour bulkhead width of 250 feet, and wider where possible.

A trip along the Harbour front will show a transformed section of the Harbour at this point. Where formerly nothing but small sailing barges and wood boats were berthed, new permanent quay walls with splendid railway connecting facilities now exist. The Harbour at this point will probably always be too narrow for the construction of piers, but by providing a commodious marginal way, the extension of the Harbour in this district is meeting with remarkable success, especially for rail and steamship traffic.

The following is a summary of the construction work at this section for the season :—

Quay walls commenced last year, completed to full height this year, 420 feet.

New cribs sunk, 480 feet.

New quay wall built to half height, 480 feet.

Cribwork, 659,000 cubic feet.

Mass concrete, 5,300 cubic yards.

Quantity of piling and cribwork in connection with the return end of the high level quay wall.

Material placed in the fill, 215,000 cubic yards.

DRY DOCK SITE.

The Dry Dock site in the eastern division of the Montreal Harbour, which made the Floating Dock and Shipyard, owned and operated by Messrs. Canadian Vickers, Limited, possible, required a considerable amount of construction work.

The site which comprises thirty acres of filled land has been formed for the Shipyard and about six acres in addition for the Right-of-Way for Harbour tracks and roadways.

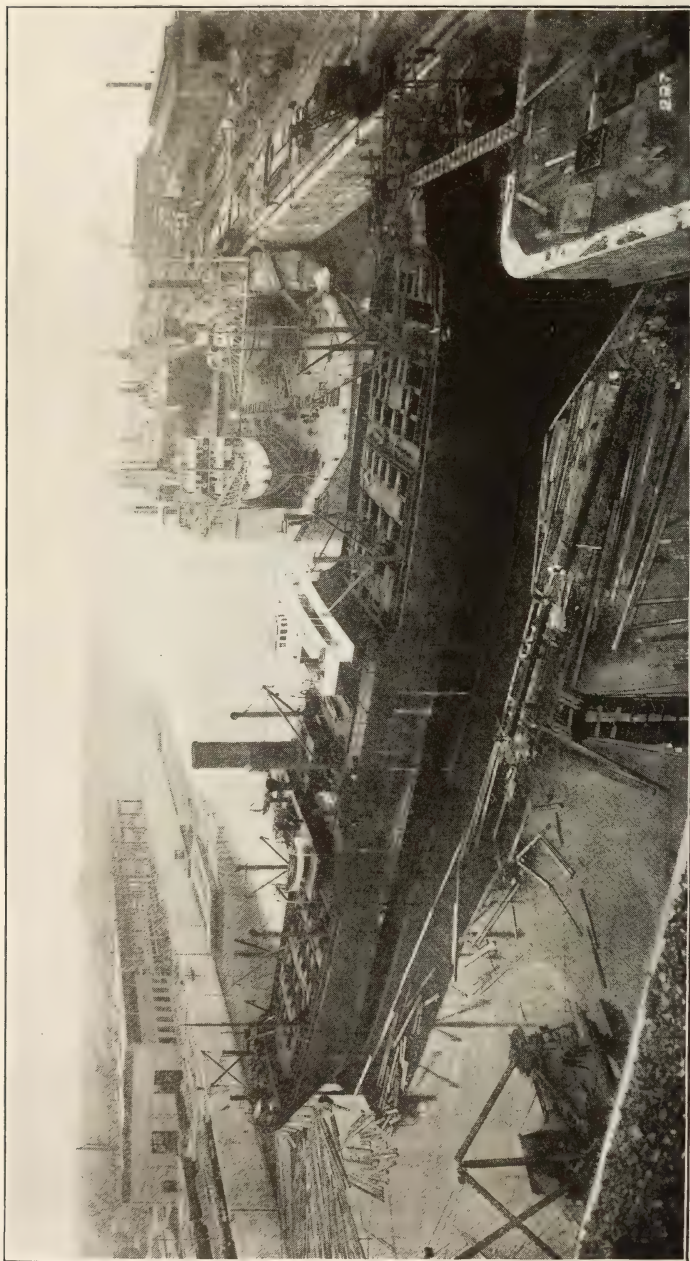
The total amount of filling required for this work was 1,850,000 cubic yards, measured *in situ*.

The reclamation of the entire area to the established level was completed by the addition of 212,000 cubic yards of dredged material.

The rip-rapping on the outer slopes, for protection, consists of rock on the edges of the slopes for a total length of about 3,000 feet.

During the season of 1915 the greatest activities prevailed at these works, as is instanced by the following statement showing the vessels docked and repaired.

H.M.S. "Carnarvon."	S.S. "Romera."
Dredge No. 8.	H.M.C.S. "Hochelaga."
S.S. "Matoa."	H.M.C.S. "Stadacona."
C.G.S. "Sable."	S.S. "Pretorian."
H.M.C.S. "Florence."	T.S.S. "Rapids Prince."
H.M.C.S. "Grilse."	S.S. "Rose Castle."
Dredge "Tarte."	S.S. "Strathcona."
S.S. "Polandia."	S.S. "Tadousac."
S.S. "Turret Crown."	S.S. "Leonard."
S.S. "Batiscan."	S.S. "McKinstry."
S.S. "Polandia."	S.S. "Sinmac."
S.S. "Turret Crown."	S.S. "Empress of Midland."



Canadian Vickers Limited, Dry Dock and Ship Repairing Plant

In addition to the above, the Company have carried out repairs and alterations to the following vessels afloat both in the Dry Dock Basin and in other parts of the Harbour:—

S.S. "Pollentia."	S.S. "Policastria."
Barge "Melbourne."	S.S. "Thespis."
S.S. "Polwell."	S.S. "Marquis Bacqueham."
S.S. "Sinmac."	S.S. "Dondiago."
S.S. "Tacoma."	S.S. "Egori."
S.S. "Shadwell."	S.S. "Huntress."
S.S. "Vienna."	S.S. "Waimere."
S.S. "Glenaffric."	S.S. "Statesman."
S.S. "Marmari."	S.S. "Harmatis."
S.S. "Dredge 110."	S.S. "Telemachus."
S.S. "Glenspean."	S.S. "Turcoman."
S.S. "Politania."	S.S. "Wayfarer."
S.S. "Royal Transport."	S.S. "Duendes."
S.S. "Frankmere."	S.S. "Cestrian."
H.M.S. "Canada."	S.S. "Mombassa."
S.S. "Dunedin."	S.S. "Mozart."

INDUSTRIAL WHARVES, POINTE-AUX-TREMBLES.

The industrial wharf constructed by the Harbour Commissioners to the order of the Canada Cement Co., between Longue Pointe and Pointe-aux-Trembles, was completed in July, 1915.

The quay walls were finished last year, but there remained a large amount of filling and grading, and the completion of the slopes, and the work was finally completed and handed over to the company on August 1st, 1915.

At midsummer, The Queen City Oil Co. applied for an industrial wharf opposite the new storage and refining plant which they were commencing. Plans were immediately made and, on being approved, construction work commenced.

This new wharf is situated about 2,250 feet below the wharf just completed for The Canada Cement Co., and is of the same character, although smaller. It provides a standard quay wall of cribwork and concrete for the berthing of a vessel of a draught up to 28 feet.

Although the order was only given on September 14, 1915, by the Harbour Commissioners, the work was proceeded with so expeditiously that at the close of the season the whole quay structure was completed, and 75% of the reclamation or filling finished. Three cribs were sunk, giving the necessary ice slopes to the quay and vertical return at the lower end. The quay front has a length of 250 feet.

The work completed during the season may be summarized as follows :—

Cribwork, 373,000 cubic feet.

Mass concrete, 1,600 cubic yards.

Material placed in the fill, 80,000 cubic yards.

RECONSTRUCTION OF JACQUES CARTIER PIER.

The quay walls of the three main piers in Montreal Harbour, completed in 1902, were built of cribwork from the foundations. The life of timber cribwork, above water level, is usually considered to be about 12 to 15 years. Below low water, the timber work in Montreal Harbour is practically permanent. It was originally intended that when the exposed part of the wooden struc-

tures decayed, the work would be rebuilt, from low water line up, in concrete.

About 7,000 lineal feet of this wooden quay wall exists, and although the timber work has lasted better than expected, it is showing considerable signs of decay. The reconstruction process carried on in the summer, when the shipping season is at its height, is hampered very greatly by vessels at their berths, and can only be spasmodically carried on between the departure and arrival of vessels. It has been reported as unwise to leave the commencement of the construction of these walls too late, as the rebuilding of 7,000 feet will cover considerable time.

Experience with mass concrete loads on wooden quay walls has shown that timber cribwork requires some strengthening, and in 1914 sheet piling was commenced on the lower side of Jacques Cartier Pier and carried on with difficulty. Owing to the urgency of advancing this work it was again commenced in 1915, and with the exceedingly valuable co-operation of the Manchester Line officials, the whole berth at Shed No. 13 was stripped down, excavated, and rebuilt on permanent lines during the season.

The new wall is excellent. The excavation in front of the permanent steel freight sheds was done in short sections, so as to cause no injury to the foundations, and increasing the width of the vertical concrete wall gave a much better railway siding.

The following is a summary of this work:

Sheet piling completed, 800 lineal feet of quay.

Excavation, 6,000 cubic yards.

Mass concrete, 4,560 cubic yards.

Refilling, 3,600 cubic yards.

LAURIER PIER CONSTRUCTION.

The upper face of the first of the three piers opposite Maisonneuve received the full force of a low-water ice shove in the spring of 1915. The Laurier Pier was built many years ago of wooden construction, and although it has on many occasions suffered damage, the whole front face of the quay wall, from the top down to nearly low water, was shoved out or damaged in the spring of this year.

Public tenders were called for this work, but, the prices being very much above the estimate, an appropriation was granted for this work, and it was completed in October at a cost well within the estimate.

SUMMARY OF QUAY WALL CONSTRUCTION.

A final summary of the quay walls constructed and advanced during the season of 1915 may be given as follows :

Cribs sunk, 1,525 lineal feet.

Quay walls built from low level to high level, 1,290 feet.

Quay walls built up to low level, 1,375 feet.

Quay walls reconstructed in concrete, 430 feet.

Quay walls reconstructed in wood, 600 feet.

DREDGING AND FILLING IN GENERAL.

The Harbour Commissioners' plant, consisting of four spoon dredges and one elevator dredge, were engaged on the usual work of dredging, consisting of maintenance of Harbour berths, dredging to ameliorate the St. Mary's Current, dredging for filling and the usual dredging required for construction work and the crib seats for wharves.

The following were the most important items of work done during the season:

Rock drilling and blasting, measured *in situ*, 29,630 cubic yards.

Number of holes drilled, 4,547.

Dynamite used, 20,594 lbs.

All of this rock was dredged by the Commissioners' dredges and used for filling of cribs and for rip-rapping slopes of reclaimed land.

Dredging in Main North Channel.

The dredge "Premier" was engaged throughout the season in removing boulders and deepening the shoal between Ile Verte and Guard Pier, for the purpose of strengthening and ameliorating the St. Mary's Current.

The main Ship Channel in the central part of the Harbour was widened to a width of 700 feet and cleaned up to a depth of 30 feet.

Dredging in South Channel.

The dredging of the South Channel was continued throughout the year, the object being to open up a channel from Moffatt's Island to opposite Longueuil Wharf, having a uniform slope and capable of taking care of a large portion of the river flow. The dredged channel, commenced at Longueuil, has been advanced until now the dredges can be seen, when working, at the upper end of St. Helen's Island. Where at low water stages the flow was formerly almost stopped, there is now a large volume of water passing through this channel, and the effect on the St. Mary's Current, opposite the New Victoria Pier, is very much improved, without affecting in the least the level in the upper part of the Harbour. The material obtained was also used in the Harbour works.

Two dredges worked practically throughout the season, dredging over an area of about $9\frac{1}{2}$ acres.

Elgin Basin Sewer Dredging.

The Elgin Basin Sewer continued throughout the season to discharge sewage into the Elgin Basin opposite Elevator No. 1.

Owing to the recent dumping of ice and snow into the city sewers, for removal, the deposit of sand from the sprinkled sidewalks and street sludge was found to be very greatly increased. Dredges can only commence when the weather has become cold and after navigation is practically closed.

Two dredges were placed on this work in November, and before being compelled to stop by the severe weather, 15,800 yards had been removed.

NEW CONCRETE ROAD, ST. LAMBERT- LONGUEUIL.

The construction of the new concrete road through the Government Farm, Montreal South, was begun on June 7th and completed November 13th. This concrete roadway is 3,644 feet long, and was constructed to a width of 24 feet. Deep rubble and tile drains were laid along the entire length on both sides of the road, and all ditches and field drains were carried under the roadway by concrete culverts.

The stone was obtained from the river shore. The labour was obtained locally, and every effort was made to complete a first-class job.

Excavation required, 4,534 cubic yards.

Rubble foundation, 5,122 tons.

Concrete, 1,673 cubic yards.

The following is an extract from a letter from the Town Clerk of the Corporation of the Town of Montreal South, to the Secretary of the Montreal Harbour Commissioners :—

“I have been instructed by the Council of the Town of Montreal South to convey through you to the Chairman and Members of the Harbour Commissioners, their thanks and congratulations on the completion of one of the best pieces of road making in the country. Your care to make a first-class job of this road has gone beyond any anticipation of the Mayor and Councillors of this Town.”

GENERAL IMPROVEMENTS.

Freight Escalator, Shed No. 16.

In order to make the second floor of Shed No. 16 more convenient for freight, an escalator was installed during the latter part of August, 1915. This escalator has a capacity of 2,500 lbs. continuously on a 40% incline, with a speed of 60 feet per minute.

New Construction Plant.

One new flat scow of standard type, 100 feet long, 30 feet beam and 9 feet depth, was built; launched in June.

The machinery for new Derrick No. 8 was built and installed, and the derrick operated successfully this summer.

The new tug, “David Seath,” was completed and put in operation, the hull being built almost entirely of oak, of the following dimensions : 77 ft. x 18 ft. x 10 ft. The machinery was constructed entirely in the machine shop, the engines being of compound type, 13 in. x 26 in. x 22 in., jet condensing. The boiler is of Scotch marine type, 10 ft. diameter by 10 ft. 1 in. over all, having two furnaces 38 in. I.D., and carrying a working pressure of 150 lbs. The tug is fitted with a steam steering gear, also con-

structed entirely at the shop. The operating of this tug has proved entirely satisfactory.

MAINTENANCE.

All latrines, fire boxes, fire stations, hydrants, shanties and tool boxes belonging to the Harbour Commissioners were painted during the season.

All the Canada Steamship Line sheds and a great number of shanties rented by various firms were given one coat of shed grey paint.

The interior steel work of Sheds 12, 13, 14 and 15 was thoroughly scraped and painted.

The exterior face of the galvanized iron sheathing of Sheds 3 and 5 was also given one coat of paint.

One hundred metal clad wooden doors in the sheds had to be replaced by an equal number of steel-framed doors exteriorly sheathed with corrugated galvanized iron.

Other wooden doors had to be repaired and kept in working order from time to time.

3,360 lineal feet of gutters, completely worn out, had to be replaced in Sheds 2, 4, 8, 9 and 11 ; also some 153 feet of downspouts.

The old style of metal chimneys in the sheds were found to have an average life of 2 to 3 years, so it was found profitable and safe to replace eleven of them with permanent brick chimneys of an average height of 42 feet.

The concrete flooring of all the sheds was patched up where found necessary.

The damage done by fire in Shed No. 24 was repaired as much as possible without interfering with the hay pressing work being done in this shed. Nine floor beams were replaced, the damaged sheathing was also renewed,

and part of the damaged concrete facade wall was taken down and rebuilt, four buttresses being added at the same time to insure stability of the whole work, considerably cracked by the fire.

Numerous other minor repairs were done on all the sheds, including those of the Tarte Pier.

A bottom concrete slab was laid in Shed No. 24.

The interiors of Sheds 46 and 47 were given one coat of paint.

The bridges connecting the team elevator hoists with sheds, as well as all subway railway bridges along the line, were painted.

The conveyor galleries and towers were also painted where found necessary.

The life-saving equipment, consisting of life buoys, life poles, etc., was maintained along the whole line of wharves and piers.

OPERATION.

Harbour Commissioners' Grain Elevator System.

The operation of the Harbour Commissioners' Elevator System during the season of 1915, as made up from reports of Mr. Jere Nehin, General Superintendent, may be given as follows:

Elevator No. 1.

Total storage capacity in bushels, 2,500,000.

First vessel unloaded, April 23, 1915.

Last vessel unloaded, November 27, 1915.

Total receipts, 17,614,950 bushels.

The above amount of grain was elevated from 62 barges and 274 steamers, a total of 336 vessels.

Delivery was made as follows:

By conveyors, 16,654,135 bushels.

To cars, 998,315 bushels.

To teams, 19,989 bushels.

Elevator No. 2.

Total storage capacity in bushels, 2,600,000.

First vessel unloaded, April 28, 1915.

Last vessel unloaded, December 4, 1915.

Total receipts, 18,602,344 bushels.

By water, 9,986,952 bushels, taken from 44 barges and 163 steamers, or 207 vessels.

By cars, 8,615,392 bushels, unloaded from 5,596 cars.

Delivery was made as follows:

By conveyors, 13,858,420 bushels.

To cars, 1,229,891 bushels.

To teams, 717,890 bushels.

By bags, 2,800,540 bushels.

Floating Grain Elevators.

Total amount of grain transferred, 846,708 bushels.

Four floating elevators were operated during the season.

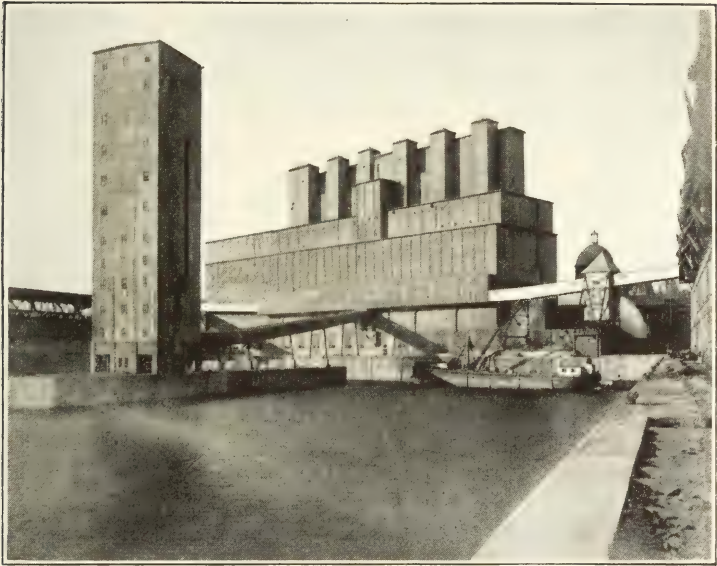
Grand Total grain handled in 1915, 37,064,002 bushels.

The features of note regarding the grain trade of Montreal during 1915, were the following:—

- 1.—The shipment of 100,000 bushels of grain to New Zealand.
- 2.—The bagging of 2,800,540 bushels of grain at Elevator No. 2.
- 3.—**The receipt of the first cars of grain, all rail, from the Province of Alberta, over the new Canadian Northern Trans-continental line, on November 18, 1915.**
- 4.—**The receipt of the first cars of grain, all rail, from the West, over the Grand Trunk Pacific, the National Trans-continental Railway, and the Grand Trunk System, to Montreal, on November 25, 1915.**

The regular number of men employed at Elevators Nos. 1 and 2, on the Conveyors and on the Floating Elevators, not including shovellers, was 119. The maximum requirements of electric power for operating the Elevator System amounted to 3,084 H.P.

No serious accidents occurred to the plant during the summer, although the wear and tear of working day and night for about thirty weeks will require a large amount of overhauling, repairs and renewals during the winter.



Grain Elevator No. 2 and Marine Tower Jetty

At the close of the season, the elevators contained 2,144,419 bushels of grain, subject to storage or delivery, as required.

The following table gives the record of the Harbour Commissioners' Elevator System from 1906 to 1915:

Year.	Total quantity of grain handled or transferred bushels.
1906.....	944,321
1907.....	1,078,289
1908.....	8,661,350
1909.....	11,691,071
1910.....	21,526,727
1911.....	21,007,164
1912.....	25,561,655
1913.....	44,000,000
1914.....	62,250,000
1915.....	37,064,002

ELECTRICAL BRANCH.

Power and Operations.

The Harbour Commissioners purchased electric power from the Montreal Light, Heat & Power Co. for their power requirements, as follows:

	H.P. Hours
Elevator No. 1 and conveyor galleries.....	1,356,565
Elevator No. 2.....	983,647
Electric hoists.....	102,670
Electric escalators.....	140
Hay presses, power and lighting.....	1,035,252
Harbour yard and machine shop.....	49,864
Electric lighting, general.....	426,000

FREIGHT HOISTS IN CONNECTION WITH TRANSIT SHEDS.

Hoist No. 1, Sheds 11 and 12.

	1914	1915
Total number of teams carried.....	7,597	4,665
Number of days in operation.....	197	184
Commenced operation.....	Apr. 27th	Apr. 23rd.
Stopped operation.....	Dec. 5th	Dec. 1st

Hoist No. 2, King Edward Pier.

Total number of teams carried.....	13,549	15,215
Number of days in operation.....	199	188
Commenced operation.....	Mch. 16th	Apr. 22nd
Stopped operation.....	Dec. 3rd	Dec. 1st

Hoist No. 3, Alexander Pier.

Total number of teams carried.....	17,269	11,707
Number of days in operation.....	193	179
Commenced operation.....	May 1st	May 1st
Stopped operation.....	Dec. 12th	Dec. 1st

Hoist No. 4, Jacques Cartier Pier.

Total number of teams carried.....	2,494
Number of days in operation.....	178
Commenced operation.....	May 3rd
Stopped operation.....	Dec. 1st

Hoist No. 5, Sheds 24 and 25.

Total number of teams carried.....	521
Number of days in operation.....	52
Commenced operation.....	Mch. 19th
Stopped operation.....	Dec. 1st

HARBOUR LIGHTING.

During the season 156 series arc lamps were in service at the various sections of the Harbour, which were maintained by the Montreal Light, Heat & Power Co. At Sections 15, and 18 to 25, 54 of our own flame arcs and nitrogen lamps were in service.

A number of 2,100 C.P. nitrogen units have been installed at Sections 24 and 25.

In general, the electrical equipment of the head office, dredging plant, transit sheds, elevators and shops was maintained and improved, the operating staff carrying on the service without delays or accidents.

FLOATING CRANE.

The Harbour Commissioners' Floating Crane was operated throughout the season as follows :—

Number of working days.....	202
Number of days working.....	134
Number of hours working.....	1,003
Percentage of time in actual operation.....	66%

TOTAL NUMBER OF LIFTS:

Commercial.....	403
Commissioners' service.....	154

AVERAGE WEIGHT OF LIFTS:

Commercial.....	10 1120-2240 tons
Commissioners' service.....	17 1120-2240 tons

GREATEST LIFT:

Commercial.....	75 tons
Commissioners' service.....	50 tons

GREATEST TONNAGE FROM SINGLE SHIP:

Ex S.S. "Manchester Shipper".....	169	852-2240 tons
Total weight lifted during season.....	6,274	1288-2240 tons
Total weight lifted during 1914.....	5,020	1477-2240 tons

GENERAL.**Wharf Accommodation.**

The extent of the wharves at the end of the season is as follows:

For 30 ft. draught at O.L.W. and over.....	25,158 lin.ft. or 4.7647 miles
For 25 to 27½ ft.....	13,442 lin. ft. or 2.5458 miles

Total deep draught.....	38,600 lin. ft. or 7.3105 miles
For 20 ft. draught and under.....	3,005 lin. ft. or 0.5691 mile

Total wharfage end of 1915...**41,605** lin. ft. or **7.8796** miles

Extent of Harbour Railway Tracks.

The extent of the Harbour Commissioners' Railway Tracks at the end of 1915 is as follows:

1. South of Lachine Canal, Bickerdike Pier, Windmill Point Wharf and West.....27,759 lin. ft. or 5.2574 miles
2. Sections 12 to 46, High Level,
Main Line Track.....50,165 lin. ft. or 9.5009 miles
To piers, elevators, cross-overs and sidings, etc.....88,560 lin. ft. or 16.7727 miles
Sections 35 to 46, Low Level,
Main Line Tracks.....12,150 lin. ft. or 2.3011 miles
Sections 46 to 71, High Level,
Main Line Tracks.....18,655 lin. ft. or 3.5331 miles
3. To wharves, industries, etc.....27,208 lin. ft. or 5.1530 miles
4. To Guard Pier.....10,400 lin. ft. or 1.9697 miles
5. South Shore, St. Lambert.....2,300 lin. ft. or 0.4356 mile

Grand total tracks on Harbour in use
end 1915.....**237,197** lin. ft. or **44.9235** miles

The usual work of dredging crib seats, deepening berths and improving the Harbour was carried out by the Harbour

Commissioners' dredges throughout the season, and excavated a quantity of 1,126,978 cubic yards.

The main ship channel in the Harbour, from Longue Pointe to the entrance to the central Harbour, is being deepened and widened by the Department of Marine and Fisheries, their work during the season in the main ship channel amounting to 495,000 cubic yards.

Total dredging in the Harbour and vicinity in 1915 : 1,621,978 cubic yards.

The sweeping of the channels and berths was carried out at intervals during the season, and, as usual, whenever any obstructions were found, dredging was carried on as soon as navigation conditions permitted.

Culverts and Raceways.

In the design of the closed basin in the central part of Montreal Harbour, it was calculated that the water from the Lachine Canal lockages, the canal raceways, and the Victoria Bridge circulating culverts, would supply enough fresh water to change the water in the Harbour frequently and keep it sufficiently pure.

The raceways from the canal water powers and the water from the waste weirs, which formerly flowed into the open river, now pass under the wharves at Windmill Point. There are eleven of these covered raceways and, since their first construction they have never ceased to be a source of trouble and expense. The volume of water is intermittent, and the air pressure, together with the rush of water, weakens the structures and scours out the foundations.

The condition of the raceways at the head of Windmill Point Basin has given much anxiety during the past year. The scour which has taken place has badly undermined the walls, and in some cases the failure has been sufficient

to cause the surface of the quay to cave in. Fortunately, this has been at a place on the wharf which is not required.

The engineers, who have made a complete examination, state that there is no remedy short of complete reconstruction. It is expected that further damage will result next spring, when active measures may be required, but in the meantime reconstruction work will be held over as long as possible, as, when the Lachine Canal entrance is ameliorated, further improvements and changes required may be incorporated with this work.

The circulating culverts near Victoria Bridge, at the head of Windmill Point, which were built in concrete in 1898, failed partially during 1913 and 1914. They were temporarily maintained by means of a rubble fill, and have so far remained without giving way completely and compelling reconstruction.

WATER LEVELS.

The following table gives the average monthly depth of water in the ship channel in the Harbour during the season of 1915, as compared with the records of 1914, and also the monthly averages of the depth of water on the old No. 1 Lachine Canal lock sill:

Month	Depth on old Lock Sill Lachine Canal				Depth in Harbour Channel			
	Average 1902-1914		Average 1915		Average 1914		Average 1915	
May.....	20ft.	4ins.	16ft.	4ins.	33ft.	3ins.	31ft.	9ins.
June.....	19 "	1 "	14 "	10 "	31 "	9 "	30 "	3 "
July.....	16 "	10 "	14 "	2 "	30 "	10 "	29 "	7 "
August.....	15 "	9 "	14 "	1 "	29 "	10 "	29 "	6 "
September....	15 "	1 "	14 "	1 "	29 "	5 "	29 "	6 "
October.....	15 "	2 "	14 "	1 "	28 "	10 "	29 "	6 "
November....	15 "	1 "	13 "	6 "	28 "	9 "	28 "	11 "

MISCELLANEOUS.

Construction Materials.

The quantities of materials used during the season were:

Cement, 33,436 barrels.
 Rubble stone, 10,735 tons.
 Sand, 11,127 cubic yards.
 Displacers, 1,800 tons.
 Crushed stone, 19,070 tons.
 Gravel, 4,500 tons.
 Railway ties, 14,220.
 Boat sides, 12.
 Timber used, 428,017 lin. ft. and 1,760,737 ft. B.M.
 Stone for macadamizing, 2,227 tons.

Labour.

The following table shows the maximum and average number of workmen employed by the Harbour Commissioners during the season of 1915:

	Maxi- mum.	Aver- age.
Maintenance.....	173	90
Harbour Yard, carpenters, blacksmiths, etc.	27	26
Sawmill and timber boom.....	29	25
Construction of wharves, tracks, etc.....	526	440
Machine Shop.....	184	110
Shipyard.....	140	119
Dredging Fleet, dredges, tugs, etc., crews...	314	314
Construction West Extension Elevator No. 1	200	80
Operation: Elevator No. 1.....	29	29
Elevator No. 2.....	36	36
Conveyors.....	40	40
Shovellers.....	88	48
Floating Elevators.....	14	14
Traffic Department.....	90	75
	<hr/> 1,890	<hr/> 1,446

DEPARTMENTAL STAFFS.

In terminating this report, the Commissioners desire to express their appreciation of the loyal services rendered by the Staffs of the different Departments during the past year.

W. G. ROSS, *President.*

FARQUHAR ROBERTSON,

A. E. LABELLE,

Harbour Commissioners.

PORT OF MONTREAL

Combined Statement showing the Number and Tonnage of all Vessels that arrived in Port during the past Ten Years.

Year.	TRANSATLANTIC		MARITIME PROVINCES		INLAND		GRAND TOTAL	
	Vessels	Tonnage	Vessels	Tonnage	Vessels	Tonnage	Vessels	Tonnage
1906.....	439	1,380,835	381	592,388	12,557	3,095,174	13,377	5,068,395
1907.....	381	1,339,014	361	586,972	14,420	3,620,950	15,161	5,546,936
1908.....	364	1,315,688	375	642,916	12,434	3,589,124	13,173	5,548,028
1909.....	371	1,436,963	299	474,450	10,991	3,146,494	11,661	5,057,907
1910.....	411	1,658,414	336	574,808	13,636	4,327,799	14,383	6,561,021
1911.....	401	1,695,613	361	642,639	11,670	4,275,019	12,432	6,613,271
1912.....	409	1,775,487	327	628,437	12,586	4,649,767	13,322	7,053,691
1913.....	477	2,020,333	343	670,202	13,426	5,703,467	14,246	8,394,002
1914.....	551	2,039,133	365	716,385	12,225	6,288,939	13,141	9,044,457
1915.....	484	1,657,728	331	603,546	8,572	4,222,426	9,387	6,483,700

PORT OF MONTREAL.

Statement showing the Classification of Transatlantic Vessels that arrived in Port during the past ten years.

Year.	Steamships.		Barques.		Ships and Brigs.		Schooners.		Grand Total.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
1906.....	420	1,372,879	3	1,872	..	.....	16	6,084	439	1,380,833
1907.....	381	1,339,014	..	.....	..	.....	..	.....	381	1,339,014
1908.....	364	1,315,688	..	.....	..	.....	..	.....	364	1,315,688
1909.....	371	1,436,963	..	.....	..	.....	..	.....	371	1,436,963
1910.....	410	1,656,794	..	.....	1	1,620	..	.....	411	1,638,414
1911.....	401	1,695,613	..	.....	..	.....	..	.....	401	1,695,613
1912.....	409	1,775,487	..	.....	..	.....	..	.....	409	1,775,487
1913.....	477	2,020,333	..	.....	..	.....	..	.....	477	2,020,333
1914.....	551	2,039,133	..	.....	..	.....	..	.....	551	2,039,133
1915.....	483	1,656,634	..	.....	1	1,094	..	.....	484	1,657,728

PORT OF MONTREAL.

Statement showing the Classification of Vessels that arrived in Port, for the last Ten Years, from the Lower St. Lawrence and Maritime Provinces.

Year.	Steamships.		Schooners.		Grand Total.	
	No.	Tonnage	No.	Tonnage.	No.	Tonnage
1906.....	367	588,980	14	3,408	381	592,388
1907.....	343	579,930	18	7,042	361	586,972
1908.....	350	640,244	25	2,672	375	642,916
1909.....	273	470,936	26	3,514	299	474,450
1910.....	306	572,022	30	2,786	336	574,808
1911.....	330	639,752	31	2,887	361	642,639
1912.....	292	625,099	35	3,338	327	628,437
1913.....	299	666,053	44	4,149	343	670,202
1914.....	321	712,327	44	4,058	365	716,385
1915.....	312	601,916	19	1,630	331	603,546

PORT OF MONTREAL.

Statement showing the Nationalities and Tonnage of Sea-going Vessels that arrived in Port during the season of 1915, that were navigated by 44,974 seamen.

Nationality	Number of Vessels	Tonnage
British.....	726	2,052,578
Norwegian.....	81	189,755
Danish.....	3	4,647
Dutch.....	1	1,652
American.....	4	12,742
Total.....	815	2,261,374

Of the above, 795 were of iron or steel with tonnage of 2,258,650 tons, and 20 were built of wood with a tonnage of 2,724 tons.

PORT OF MONTREAL.

Statement showing the dates of the Opening and Closing of Navigation, the First Arrival and the Last Departure for sea; also the Greatest Number of Vessels in Port at one time, during the past Ten Years.

Years	Opening of Navigation	Closing of Navigation	First Arrival from Sea	Last Departure for Sea	Greatest Number of Vessels in Port at one time			
					Sea-going		Inland	
					No.	Date	No.	Date
1906.....	April 20th	Dec. 2nd	April 28th	Dec. 2nd	26	May 28th	124	July 8th
1907.....	" 23rd	" 15th	May 2nd	Nov. 29th	29	May 24th	103	July 8th
1908.....	" 22nd	" 10th	April 30th	" 26th	24	June 21st	104	June 30th
1909.....	" 16th	" 27th	" 23rd	" 28th	22	Nov. 9th	107	Aug. 31st
1910.....	" 1st	" 7th	" 11th	Dec. 1st	25	May 18th	122	Sept. 18th
1911.....	" 23rd	" 29th	" 26th	" 3rd	24	Aug. 18th	85	June 5th
1912.....	" 23rd	" 21st	" 30th	" 3rd	22	July 31st	86	Aug. 21st
1913.....	" 9th	" 27th	" 19th	Nov. 29th	29	Oct. 3rd	92	July 25th
1914.....	" 22nd	" 15th	" 29th	Dec. 4th	56	Aug. 21st	94	Aug. 17th
1915.....	" 11th	" 15th	" 30th	" 11th	34	Sept. 21st	66	July 26th

LIST OF HARBOUR COMMISSIONERS DREDGING PLANT, 1915.

Description of Vessel.	Hull.			When built	Engines					Capacity of bucket c.y.	Depth to which Dredge can work	Remarks	
	Length	Breadth	Depth		Kind of Engine	No. of cylinders	Dia. of cylinders inches	Length of stroke inches	Pressure of steam lbs.				
Dredges.													
Boom Spoon Dredge J. Kennedy	90	0	36	0	10	3	1892	Horizontal non-condensing	{ 2 2 2 2 }	{ 16 16 16 16 }	{ 18 18 18 18 }	{ 128 140 140 140 }	Wooden hull. Steel hull. Steel hull.
" " " No. 4	90	0	36	0	10	9	1900						
" " " No. 5	104	0	36	0	10	9	1910						
" " " No. 6	104	0	39	0	10	9	1912						
Elevator Dredge "Premier"	86	0	31	5	9	2	1905	Horizontal high pressure	2	14	15		Wooden hull.
Derricks.													
Clam shell Derrick No. 1	76	0	27	6	8	0	1899	Horizontal high pressure	{ 2 2 2 2 2 2 2 2 }	{ 12 10 12 12 12 12 12 12 }	{ 14 12 12 14 14 14 14 14 }	{ 110 120 110 110 110 110 110 110 }	Wooden hull. Wooden hull. Wooden hull. Wooden hull. Wooden hull. Wooden hull. Wooden hull. Wooden hull.
" " " No. 2	80	8	30	0	7	6	1900						
" " " No. 3	76	0	27	6	8	0	1900						
" " " No. 4	75	0	26	10	7	6	1892						
" " " No. 5	75	0	26	10	7	6	1892						
" " " No. 6	75	0	26	10	7	6	1892						
" " " No. 7	88	0	31	0	9	0	1913						
" " " No. 8	88	0	31	0	9	8	1915						
Drilling & Blasting Boat	80	0	27	0	5	6	1895						Three 5 in. steam drills.
Drill Boat No. 1	60	0	20	0	5	0	1909						Two 5 in. steam drills.
Tug Boats.													
Tug "St. Peter"	74	8	16	1	8	6	1875	Vertical non-condensing	{ 1 1 }	{ 20 10 }	{ 22 12 }	{ 125 125 }	Wooden hull. Rb't. 1903 Composite hull.
" " "Courier"	36	9	9	3	6	2	1900						

" " Aberdeen	79	3	18	3	9	0	1895	Vertical con- densing	{ 1 } { 1 } { 1 } { 1 }	{ 32 } { 16 } { 32 } { 16 }	24	120	Steel hull.
" " Robert Mackay"	80	9	17	6	10	0	1899		{ 1 } { 1 } { 1 }	{ 16 } { 32 } { 16 }	24	125	Steel hull.
" " Alphonse Racine"	90	0	18	6	12	1	1905		{ 1 } { 1 }	{ 16 } { 32 }	24	150	Steel hull.
" " No. 1	90	0	26	0	6	0	Reblt. 1893	Horizontal non- condensing	1	15	20	100	{ Iron sheathed with elm. Formerly Floating Ele- vator, No. 1.
" " Sir Hugh Allan"	130	0	26	6	15	0	1911	Vertical triple expansion condensing	3	{ 16 } { 25 } { 40 }	24	180	Steel hull, twin screws.
" " Hon. John Young"	91	8	22	0	9	0	1911	Vertical compound condensing	2	{ 12 } { 24 }	18	140	Steel hull, twin screws.
" " Beaver"	64	3	15	3	7	3	1892	Vertical high pressure	1	18	20	115	Wooden hull.
" " Passe-Partout"	49	1	11	3	5	7	1912	Vertical high pressure	1	9	10	125	Wooden hull.
" " David Seath"	75	0	19	0	10	2	1915	Vertical condensing	{ 1 } { 1 }	{ 13 } { 26 }	{ 22 } { 22 }	150	Wooden hull.
Testing boat	{ 73 } { 73 }	3 3	14 14	0 0	3 3	1 1	{ 1897 }						Two wooden scows braced 16 ft. apart.
Scows.													
2 Flat deck scows Nos. 2 & 4	75	0	20	2	6	0	1876	Capacity.					
1 " " No. 10	90	0	20	0	5	5		67½ yds.					
2 " " Nos. 21 & 22	85	0	25	0	7	5	1891	80 "					
2 " " Nos. 23 & 24	85	0	25	0	6	9	1891	150 "					
5 " " Nos. 25-29	85	0	25	0	6	9	1892	150 "					
5 " " Nos. 31-35	85	0	25	0	6	9	1893	150 "					
2 " " Nos. 39 & 40	85	0	25	0	6	9	1903	150 "					
2 " " Nos. 41 & 42	87	0	25	0	7	6	1904	150 "					
12 " " Nos. 43-54	100	0	30	0	9	0	1911-15	300 "					
2 Dump scows, Nos. 36 & 37	106	0	26	10	9	6	1899	200 "					
1 " " No. 38	106	0	26	10	9	6	1900	200 "					
2 " " (Gilbert's)	60	0	20	0	6	0		100 "					
1 large coal scow	138	0	32	0	8	5		400 tons.					
1 floating concrete machine	100	0	34	0	8	6	{ 1915 } { Reblt.						
1 floating pile driver	50	9	24	2	5	8	1896						
1 floating air plant													{ Converted floating grain elevator.

HARBOUR DREDGING.

Statement showing the number of days worked by each dredge and the quantity dredged at each place in the Harbour of Montreal in 1915.

Name of Dredge.	Places at which dredging was done	Time of Service		Quantities dredged		Character of Material dredged.
		Days	Total	Cu. yards	Total yds.	
Dredge "John Kennedy".	New Channel South of St. Helen's Island.....	229½	229½	140,500	140,500	Compacted disintegrated shale, hard pan and boulders.
Dredge No. 4.....	Maintenance Dredging, New Channel South of St. Helen's Island.....	3		1,800		Sand and gravel.
		255½		201,000		Compacted disintegrated shale, hard pan and boulders.
Dredge No. 5.....	Market Basin, cribseats..	7½	266	4,600	207,400	Sand, earth, stones and old timber cribs.
	Maintenance Dredging...	10½		8,100		Sand, silt and debris.
	New Channel South of St. Helen's Island.....	251¾		346,248		Gravel, stones and hard pan.

Dredge No. 6.....	Windmill Point Basin..... Sections 100-101.....	10½ 47¾	320½	8,100 126,900	489,348	Blasted rock. Clay.
	Windmill Point Basin..... Maintenance Dredging...	83 30		53,550 23,300		Blasted rock. Sand, gravel, silt and debris.
	Approach Channel, Dry Dock.....	14 28		15,900 15,000		Gravel and silt. Sand, stones, earth and old timber.
	Inside Guard Pier.....	124		138,260		Unblasted rock and hard pan.
	Victoria Pier, cribseats...	29½		29,750	275,760	Sand, stones, earth and old timber.
			308½			
	Between Ile Verte and Guard Pier.....	139		13,970	13,970	Gravel, hard pan and boulders.
GRAND TOTAL...			1,263½		1,126,978	

APPENDIX

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PACIFIC PORTS.

The enormous development of seaports in recent times makes it every day a matter of increasing importance that ship owners, merchants, captains, and all connected with the export and import trades of a country, should have ready at hand full up-to-date knowledge of the facilities provided at the various shipping depots.

It is none the less to the interest of Harbour authorities and citizens that they should learn of the methods adopted at ports other than their own, whilst the welfare of the country generally is obviously also promoted by that larger knowledge which leads to emulation and consequent progress.

To describe herein the Ports visited with anything like the minute detail dealt with in the original report is impossible, but in order to meet numerous requests received, the following pages are written dealing briefly with the general facilities created at the different ports, not with a view to making invidious comparisons, but with the sole object of providing information which might be of interest, particularly to those belonging to the shipping and mercantile industries.

OWNERSHIP AND CONTROL.

A harbour is essentially public. The right to embark and disembark again to the land should be as free as the people whose property it is. Such is the trend of public thought on the Pacific Coast at the present time in favour of public ownership and control of port facilities, under the jurisdiction of live commissioners.

The communal instinct and effort in behalf of getting trade is universal and as old as the history of commerce.

The Phoenicians and Greeks built harbours; the ancient seaports of Carthage, Athens, Venice, Genoa, and the rest were the direct product of public enterprise, as was also the growth of the towns of the Hanseatic League and other ports of the Middle Ages. All the ports of Europe have been developed by the same method in various forms.

The seaports of Great Britain, London almost excepted, owe their growth and prestige to public effort.

On the Pacific Coast the same necessity for united action and unwillingness to rely on the result of individual interest is indicated in the situation at San Francisco, where the State has owned the wharves since 1863; at Los Angeles where, in 1909, in order to get full control of the Harbour, San Pedro and Wilmington were by consolidation brought within the city limits and consequently under municipal jurisdiction; at San Diego where in 1911, by Act of the State Legislature, the city was granted absolute control of its water front and the tide lands adjacent thereto; at Seattle where by the vote of the people the Port of Seattle Commission was organized in 1911 to develop that port in keeping with the large increase in its water commerce, and where millions have since been spent in purchasing the water frontage which should never have been parted with at all.

At Portland, Oregon, in 1912 the Commission of Public Docks was organized with jurisdiction between the pier-head line and the bulkhead line, and \$2,500,000 have been expended since that date in the acquisition and construction of municipal docks; at Vancouver also the need of publicly owned wharves brought about in 1913 the organization of the Harbour Commissioners of Vancouver; in fact, we might indeed go on and name almost every American seaport of note and cite them as evidence of the decision

on the part of their respective communities that their success in commerce depends on their united public action, and that individual initiative cannot be relied on to supply a uniform, economical and stable system for developing, in the face of the keen competition of to-day, the accommodation and facilities required for a great commerce.

The policy of public ownership of docks had its origin in remote antiquity, in those ancient seaports whose names are preserved to posterity as having been centres of commerce and trade.

That private ownership should exist in this country is only natural, because commerce rose from a small beginning and as a result of individual enterprise. Abundance of room invited occupancy without infringement on the rights or convenience of others, and the nascent public encouraged every enterprising tendency.

There has come a time, however, when inconvenience, or increase in cost, or necessity for economizing, or lack of business, or congested conditions, or some other moving reason brought about a change, and an effort to adapt things to more satisfactory ends, and this has been particularly so on the Pacific Coast, where, according to an estimate of Gen. Chittenden, probably \$50,000,000 will be expended during the present decade in port development in order to get ready for the huge increase in business which every port expects to derive from the Panama Canal.

Cost what it may, the people are determined to regain control of their water fronts, and to preserve to the public forever the right to use the wharves and docks for such purposes and in such manner as the public welfare from time to time demands.



View of San Diego Bay, showing coal bunkers, wharf in foreground, and Municipal pier in near background.

SAN DIEGO.

The Port of San Diego, California, discovered 370 years ago by the navigator Cabrillo, is situated 89 miles south-easterly from Los Angeles, on the eastern shore of the splendid land-locked San Diego Bay, and possesses, in a generous degree, all the natural endowments required by man for the development of one of the finest seaports of modern times, being located in a region of perpetual summer and free from disastrous storms.

The Port is a powerful competitor of Los Angeles, notwithstanding the disadvantages of its close proximity to Mexico and its poor location with reference to the rail routes east, as well as the drawback of its tributary hinterland not being as favourable as its sister city.

Its entrance channel at Point Loma has a depth of water over the bar at low tide of 39 feet and a width of 600 feet, with an average tidal range of $3\frac{1}{2}$ feet, and navigation through the same is controlled by an adequate signal system.

The main channel inside the bay, which has an area of 22 sq. miles, averages from 1500 to 2000 feet in width, and from 35 to 70 feet in depth at low water, and is splendidly lighted and buoyed by the United States Government.

The present berthing accommodation of the Harbour amounts to about 6,000 lineal feet, and the entire development is one of the pier type, being constructed from the bulkhead or shore line to deep water.

With the exception of the Municipal Pier, all the piers and wharves in the Harbour are private property and are constructed of untreated piles encased in cement.

On the opposite side of the bay at Coronado, the United States Government maintains a Torpedo Boat

and Submarine Station, together with quarantine and coaling depots, and on the San Diego side are located within the harbour numerous fish canneries, machine shops, etc.

Ships' winches are used exclusively in the loading and unloading of cargo, the prevailing methods of handling being between ship and warehouse and ship and railroad car.

There is no Dry Dock in the Port, but a Marine Railway capable of accommodating vessels up to 1,000 tons burden is available.

As already stated, the Port suffers considerably through its lack of railway connections, the only railway running to the port being a branch line of the Santa Fe from Los Angeles.

Steamships.—Eleven lines at present make San Diego the southern terminus for their steamships.

Being the first port of call in United States territory for all incoming vessels, and the last port of call for all outgoing vessels plying between the United States Pacific ports and the Panama Canal, considerable increase in the tonnage of the port is expected in the near future.

The number and tonnage of vessels arriving in the Port have increased from 354 vessels with a tonnage of 254,090 tons in 1904, to 689 vessels with a tonnage of 1,044,676 tons in 1914.

Prior to 1911 the Harbour of San Diego was owned and administered by the State of California, the Legislature in 1910 voting \$1,500,000 for its development, which, however, was never spent because of representations made by the municipality that the development of its waterfront should be placed under its own control.

By Act of the Legislature in May, 1911, the City was accordingly granted control of its waterfront, and the tide lands adjacent thereto.

This generous gift was made upon the condition that the City expend within three years from the above date, the sum of one million dollars in improvements in the Bay of San Diego. In November, 1911, bonds to the aforementioned amount were sold, with which money there have been completed the following:—

(a) The Municipal Pier, 130 feet in width by 800 feet in length, founded on reinforced concrete piling, having a reinforced concrete floor slab, with asphalt-wearing surface, covered with a single storey transit shed, 734 feet 5 inches long and 72 feet 5 inches wide. This shed is equipped with steel rolling doors, and is erected in the centre of the pier, 28 feet back from its faces, thus permitting of two standard surface railway tracks being laid between the shed and the water on each side.

(b) The construction of 6,680 feet of temporary and 2,672 feet of permanent reinforced concrete bulk-head, and the reclamation of 80 acres of tide lands.

A depth of 35 feet is maintained alongside the pier and a depth of 20 feet in front of the bulkhead, which, however, can be increased at any time shipping demands such.

(c) The erection of an administration building at the shore end of the Municipal Pier, having a length of 45 feet 5 inches and a width of 75 feet.

(d) In addition to the above, the City has also constructed two dredges and still retains one, which is employed intermittently in dredging around the harbour.

The Port now enjoys the possession of a tract of tide lands comprising an area of 1,460 acres, lying adjacent

to the City, constituting its water front, about 16 miles in extent. The filling-in of the tide lands is being gradually accomplished by the operation of the Municipal dredge.

To date, \$1,400,000 have been expended on the entire project.

As the appropriations granted have all been practically expended, no further improvements are proposed to be carried out in the immediate future.

The administration of the Port is vested in the hands of the Manager of Operations, the Harbour Master and Assistant Wharfinger, all appointed by the City, which now controls that portion of the waterfront between the mean high tide line and the pierhead line. Private property within these limits may be taken over at any time by the City upon payment of actual value.

The Board of Harbour Commissioners, appointed by the State of California, controls the open waters of the Bay of San Diego.

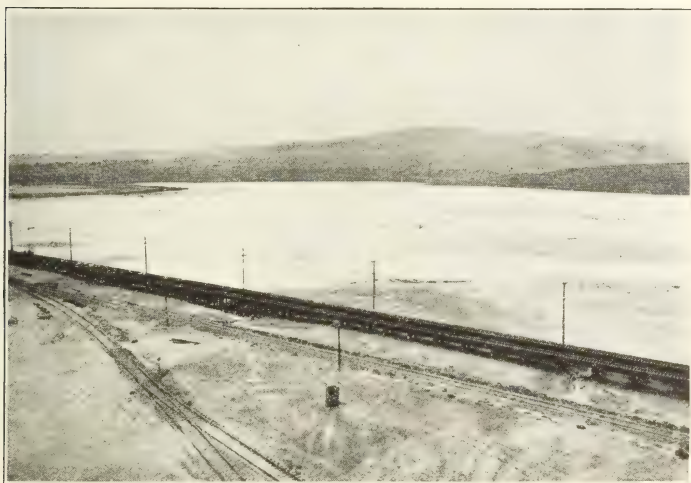
The Police and Fire Authorities of the Port are vested in the Municipality of San Diego.

The Pilotage Board, also a creation of the State, appoints the pilots.

LOS ANGELES.

Los Angeles, an inland city some 21 miles from the Pacific Ocean, the location of highest strategic value in Southern California, from a commercial point of view, became aroused less than a decade ago to the need for progressive port development—largely by the hope that the Panama Canal would mean an increase in the volume of shipping on the Pacific Coast

The only possible port was the harbour of San Pedro, adjacent to the villages of San Pedro and Wilmington, which by themselves were unable to develop port facilities on a public basis or in a manner to serve the requirements of Los Angeles, whose relation to the great southern trade routes east, resources in agriculture and close proximity to the oil fields, makes it the centre of activity in Southern California.



Undeveloped Tide Lands—Part of Los Angeles Harbour, 1893.

As a preliminary step towards actively aiding in harbour development, the City of Los Angeles in 1906 extended its boundaries by annexing what is known as "the shoestring strip," a quarter of a mile wide, extending from its boundary to the limits of the harbour towns, and in 1909, in order to get full control of the harbour, San Pedro and Wilmington were, by consolidation, brought within the city limits, and consequently under the municipal jurisdiction of the City of Los Angeles.

While the real development of the harbour was begun a year later, the Bay of San Pedro had been for a long time a port of call for ships, affording comparatively safe anchorage, for the high headlands on which the town was located sheltered the bay from the west, and Santa Catalina Island, 22 miles long and 20 miles to the southward excluded to a great extent gales from that direction; but the ocean shoaled rapidly towards the shore, and the land lying between San Pedro and Long Beach was composed of only marshes and flats traversed by small channels and shallow lagoons, cargoes being transported to and from ships by small boats, men frequently wading into the ocean with loads on their backs.

The transforming of the inland town into a seaport and the marshes and flats into a modern harbour for deep draught ocean-going vessels, wholly artificial, nature not having lent itself in the slightest degree, is an everlasting monument to the indomitable courage, perseverance and faith of its enlightened citizenship, whose ambition it is to make the facilities of the Port of Los Angeles the best possible, and to lower the cost of handling traffic to a minimum, so as to encourage commerce and industry.

The Harbour consists of two distinct parts, the "Outer" and "Inner" Harbours, connected by the gorge at Deadman's Island, which name has been changed to "Reservation Point."

Outer Harbour.

The entrance to the Outer Harbour is 4,000 feet wide, with 30 to 50 feet of water at low tide, the mean tidal range being 5 feet and the extreme 9 feet.

Exposed to storms more or less from the southwest, the most conspicuous improvement in this section is the



LOS ANGELES—The Great San Pedro Breakwater, over two miles long

great breakwater, one of the largest in the United States, extending from Point Fermin easterly a distance of 11,152 feet to a depth of 52 feet at mean low tide, and curving so as to embrace the anchorage (498 acres, 30 to 50 feet deep, and 111 acres additional over 24 feet) and shelter the entrance to the inner harbour, which is behind the inner end of the structure.

The breakwater, the construction of which was begun in 1899 and completed in 1912 at a cost of \$3,038,703.00, is 198 feet thick at the base, 62 to 66 feet high the greater part of the length, and 20 feet wide at the top. Up to low water it is a rubble mound, the stones weighing from 100 lbs. up to 15 to 20 tons. Two-thirds of them average 1,000 lbs. each. The superstructure extending from low water up to 14 feet above, is laid from rectangular granite blocks, those on the ocean side weighing not less than 16,000 lbs. The outer end of the breakwater is composed of a massive monolith of concrete,

40 feet by 40 feet by 20 feet high, upon which has been erected a magnificent lighthouse, rising approximately 70 feet above the water, with a flashing light of 140,000 candle power.

Upon the construction of the breakwater and lighthouse, the dredging of the main channels and the provision of jetties to control currents, the United States Government has expended to date about \$5,800,000.



LOS ANGELES—Municipal Pier No. 1, Outer Harbour.

The character of the harbour bed is mostly soft material, with some clay in the Outer Harbour.

Across the entrance channel from Reservation Point the City has constructed a bulkhead to reclaim about 154 acres of land, on the west side of which has been built Municipal Dock No. 1, a concrete wharf of reinforced concrete sheet piles, riprap bulkhead, with column foundations for the transit shed 2,520 feet long, at a cost of \$475,000.00. Upon this wharf has been erected, at a

further cost of \$268,000.00, one of the finest transit sheds seen on the trip, 1,800 feet long by 100 feet wide, one-storey steel frame construction, asbestos roof and sides, equipped with cargo masts, and a sprinkler system, as well as a water tank for the auxiliary fire protection of the building, with a capacity of 75,000 gallons, centrally located.

A great demand having arisen at this Port for storage space, the Harbour Commission proposes to proceed at once with the erection of the first of a series of warehouses at the rear of Municipal Dock No. 1, which will be of reinforced concrete throughout, 150 feet by 480 feet, seven storeys high, equipped with four elevators and cargo masts over the doors along the two sides, a sprinkler system, and served by two railway tracks. The cost of this accommodation will be \$300,000.00.

The opposite side of the slip is occupied by the wharf and freight shed of the Outer Dock & Wharf Co., constructed on a fill of about 132 acres, enclosed by nearly 12,000 feet of bulkhead construction. This Company has constructed 5,400 feet of wharf frontage, with rail connections, and a transit shed 1,433 feet long.

Adjacent to the shore end of the breakwater, a further fill is contemplated where two more municipal docks will be constructed as soon as the trade warrants such an expenditure.

Inner Harbour.

The entrance to the Inner Harbour at Reservation Point is completely sheltered by the breakwater, and has a width of 700 feet broadening out to 1,000 feet about half a mile in. It then narrows to 500 feet, which width is retained for nearly a mile, increasing somewhat

from that to the termination of the channel, a little over two miles, from the outer end, into a turning basin 1,600 feet in diameter. From the turning basin channels lead off to the main interior docks, known as the East and West Basins, and which in a short time will become the centre of the Harbour of Los Angeles.

From Reservation Point the banks of the channel have been improved all the way to the Turning Basin with railway facilities, the Southern Pacific and Salt Lake Systems, as well as many other private interests being located in that section of the harbour.

There exists in the Inner Harbour about 26,000 feet of wharf frontage, as follows :—

Owned by the Municipality.....8,780 feet.

Owned by the Railroads.....7,731 feet.

Owned by Private Interests.....9,488 feet.

Single storey sheds are the rule in Los Angeles, and, with the exception of the shed of the Outer Harbour Dock & Wharf Co., all of them owned by private interests, are very narrow.

One of the greatest improvements under way in the Inner Harbour consists of the widening of the channel to 1,000 feet, doubling its present width. This improvement involves the destruction of all the wharves and the construction of new wharves along the right bank of the channel. The work is being carried out without in any way interrupting commerce by cutting the new channel back of the existing wharves, which are left intact, constructing the new wharves and then removing the old structures. This new channel will allow room for large vessels to lie at the wharves on the opposite sides of the channel, with lighters alongside of each vessel, and still



Inner Harbour—San Pedro District Waterfront.

provide ample room for navigation in the fairway for all craft.

On the north side of the Turning Basin lies Mormon Island Channel, around which all the land has been reclaimed and now stands high above the reach of tide-water. In the basin at the end of this channel the City has recently built pier "A," having a frontage of 2,055 feet, now used by the vessels of the American Hawaiian Steamship Co.

From the east side of the Turning Basin runs a channel 30 feet deep, with a width of 150 feet, to give access to the Wilmington Basin, where Water St. Wharf is located. This basin is the home of many small craft, motor boats and sailing yachts. The same channel leads to East Basin, practically undeveloped at present, which is connected with the Harbour of Long Beach by a small and crooked channel, navigable for only small craft at high tide. An entirely new channel

is proposed to be constructed connecting the two Harbours, which will make one great Harbour.

The development of Los Angeles Harbour is one of riverside quays and piers, constructed, with two exceptions, entirely of creosoted piles.

The Port is not equipped with freight handling devices of any kind, although the harbour authority at present has under consideration the purchase of a 20-ton Browning crane. Cargo is handled between ship and wharf by the ships' winches.

A very small importing grain elevator is operated by one of the milling companies in the Port for its private business.

A dry dock does not exist in the Port. A small one of the floating type, however, is located at Long Beach Harbour, owned and operated by the Craig Shipbuilding Co. The need of such a facility at Los Angeles is keenly felt since the opening of the Panama Canal, and the establishment of a dry dock and shipyard is one of the important projects under consideration. A site at the western end of the Turning Basin is admirably located for such a development, and every endeavour is being put forth by those interested to provide, with the least possible delay, such accommodation for vessels, which it is felt would be a decided attraction to shipping.

The centre of Los Angeles being situated 21 miles from the Harbour, the principal type of port business there employed is from ocean or coasting vessel to railway cars, a small amount of business being conveyed by motor truck, which, however, has been increased during the past 18 months, prior to which the entire transportation of cargo between the Port and the City was done by the railways.

The rails of the Salt Lake, Southern Pacific and Santa Fe Railroads enter the City of Los Angeles, but two of them, the Salt Lake and Southern Pacific, extend to the harbour, which has connection also with the Pacific Electric, an interurban railway system.

The City has laid tracks on its outer and inner harbour docks, but at present there is no physical connection between the two, and in September, when the Port was visited, the Commission had practically completed negotiations with the various railway lines relative to a common railway terminal, or belt line, under municipal control, serving all the wharves in the Harbour.

Until the city is in a position to take over and operate all of the tracks within the Harbour, the above arrangement appears to be one that will provide a satisfactory solution of the problem of giving access to every wharf in the harbour to every railroad upon equal terms.

There are two fire boats in operation in the Port, which also perform towage service.

Up to the present no industries have been established adjacent to the harbour, but this feature of development is now being energetically taken up by the Harbour Commission.

During the past two years there have been added to the steamship lines operating from the Port two European Lines, the Blue Funnel and the Johnston Line, as well as the Toyo-Kisen Kaisha Lines to Japan, and the Panama-Pacific Line conducting a service between Los Angeles and New York.

In 1902 there were only two regular lines using this harbour—The Pacific Coast Steamship Co., which had two small ships, and the Wilmington Transportation Co.

At present no less than 20 lines operate to the Port.

The exports of the Port are fruits, canned goods, sugar, olives, beans, cotton, petroleum and by-products.

The imports are flour, grain, sugar, iron, steel, oil, paper and lumber.

The population of the City has grown from 102,000 in 1900 to 500,000 in 1915.

Administration.—The Harbour is administered by a Harbour Commission, established in 1910, consisting of three Commissioners, appointed by the Mayor for a term of four years. A Commissioner is placed in charge of each of the three departments, viz., Bureau of Construction and Maintenance, under which are the engineering forces; Bureau of Traffic and Commerce, containing the traffic forces, publicity agent, etc., and the Dept. of Operation and Control, under which are the pilots, wardens, wharfingers, clerks, etc.

The Board is confronted with the task not only of developing the harbour from a municipal standpoint, and building municipal utilities in connection therewith, but the government of private utilities is placed in its hands. It is the duty of the Board not only to construct municipal harbour improvements, and operate them so as to make them pay, but also to build up the commerce of privately-owned utilities—in fact, to develop the water commerce of Los Angeles generally. This is the idea of the members, so as to attract commerce.

As a result of the consolidation of the Harbours of San Pedro and Wilmington, this Commission pledged itself to spend on harbour improvements within 10 years from 1909, \$10,000,000. Since 1912 Harbour Improvement Bonds to the extent of \$5,500,000 have been sold, and the money spent on dredging, construction of wharves,

freight sheds, terminals, paved harbour approaches, and purchase of right of way, and there is at present unexpended of the above amount, available for future development, the sum of \$800,000.00.

The Harbour Commission is also the Pilotage Authority of the Port, and pilotage is not compulsory, provided the Master of the vessel entering is in possession of a license granted by the United States Government.

The Fire and Police Authority is the Municipality of Los Angeles, which also lights the Harbour and sheds owned by itself.

SAN FRANCISCO,

The largest and most important port of the Pacific Coast, is situated on the narrow peninsula lying between the southern half of San Francisco Bay and the Pacific Ocean, south of its entrance through the Golden Gate, which is about a mile wide, very deep, and has a tidal current of about seven miles per hour at spring tides.

The harbour is perfectly sheltered from ocean storms, is not subject to flood effects, and is absolutely free from ice.

Its extreme tidal range is only 8 feet and the mean less than 5 feet, and because of the scouring effects of the tide the water is very deep, varying from 33 feet at the sea wall, which is the minimum required by law to be maintained, to from 50 to 75 feet at the outer ends of the piers, the pierhead line having been established by the United States Government about 800 feet from the sea wall or bulkhead line.

The waterfront varies greatly in its foundations—from rock and hardpan to mud, which in certain places is very deep and in others extremely soft.



Bird's-eye View of San Francisco Harbour and the Golden Gate.

The waterfront along which improvements have been made has a length from Fisherman's Wharf to Central Basin of $3\frac{1}{2}$ miles, and Channel Street (a waterway) has a frontage of $1\frac{1}{4}$ miles, making $4\frac{3}{4}$ miles of waterfront in use for commercial purposes. In this stretch there are, under the control of the State Board of Harbour Commissioners, 32 piers in service, 2 under construction, and one for which a contract has just been let. Of the piers now in use, two are supported on untreated wooden piles, eight on creosoted piles, two on wooden piles incased in concrete shells, eleven on cylinders of plain concrete and nine on reinforced concrete cylinders of modern type of construction. Of those under construction, one is of creosoted, the other of concrete piling.

The piers and bulkheads at present offer about nine miles of berthing space, which may be extended as the population and commerce demand until it will cover around 50 miles.

Piers Nos. 16 and 18, completed early this summer, are each 140 feet in width, 680 feet in length, and are equipped with sheds 100 feet in width, leaving spaces outside the sheds of 21 feet on the north side and 19 feet on the south side, upon which are located railway tracks. The north track is depressed so that the car floors are approximately at the elevation of the pier deck, and the south track is flush with the deck of the pier.

With one exception, all the sheds in this harbour are of the one-storey type, constructed of timber, and are 22 feet high to the lower chords of the trusses. The main trusses span from the north side of the sheds to the passenger galleries, 10 feet from the south side, so that the centres of the sheds are free from columns. Monitors with continuous windows extend the full length of the



SAN FRANCISCO—View of Modern Pier showing Depressed Track.

sheds, and these, together with the windows along both sides, furnish ample lighting.

The doors are Kinnear steel rolling doors, and in general the openings are 18 feet in height and 19 feet in width, alternating with closed wall panels 21 feet in width.

In order to enable passengers to reach the steamships without the necessity of dodging the teams and long-shoremen on the main deck of the piers, a passenger gallery is provided along the south side of each pier, 10 feet in width, and is reached by a ramp which starts near the front of the shed and slopes up on a 20 per cent grade. Two flights of stairs also lead to each gallery, one near the centre and one near the end of the shed.

The galleries communicate with the ships by means of passenger aprons, two to each pier, which are adjustable in height to suit tidal changes.

The driveways of the piers are paved with Ohia wood blocks from Hawaii, the cargo space on each side of the driveway and the space outside the sheds being paved with asphalt laid directly on the plank deck.

An idea of the size of the piers constructed in this harbour within the past year is here given:—

Pier No.	15....	794 feet long....	90 feet wide.
“	16....	685	“ 140 “
“	18....	685	“ 140 “
“	35....	896	“ 200 “
“	37....	945	“ 200 “
“	41....	981	“ 200 “
“	46	800	“ 200 “

The distance between the bulkhead and pierhead lines being only 800 feet, as already mentioned, it has been necessary in the construction of piers over that



SAN FRANCISCO—Interior of Transit Shed.

length to incline them at an oblique angle to the sea wall, in order to get length sufficient to accommodate the mammoth ocean liners expected in the port in the near future. Provision is made to extend the above piers to a length of 1,100 feet when necessary.

All of the piers and sheds within the harbour have been constructed by the Harbour Commissioners, and with the exception of four of them, are assigned (not leased) to Steamship Companies and others from month to month, although in practice the tenant is seldom disturbed. Such assignment of a wharf does not give a tenant exclusive use thereof, but merely the first call to use it when he has a ship in port or soon to arrive. When the berth is vacant, tramp and other vessels may be accommodated, but not so as to interfere with the tenant's use.

No leases are permitted by law, except of the four wharves referred to above, built under the provisions of a special statute, which required the Lessees to advance the cost of the wharves, in return for which they receive 15 years' lease free of rent, such leases providing for the exclusive use of the wharves for their own vessels.

The lease system has been entirely abandoned in San Francisco, only assignments being now granted from month to month.

In addition to the accommodation for tramp vessels at piers, in the absence of regular liners, there are two open piers kept available for this service, all vessels arriving in the port, no matter from whence they hail, being given berths in their regular turn.

By the construction of a sea wall having a length at present of 14,210 feet, and the filling of the space behind it, land has been created, known as sea wall lots. These lots, 27 in number, are leased for purposes which will be

most advantageous to the Port, consistent with its navigation and commerce, such as warehouses, industries, etc., at a rental equal to 4 per cent per annum on the valuation of the same. Eighteen of these lots may be leased for periods not to exceed 25 years, but the last nine reclaimed are only to be rented from month to month. Many of them have already been leased by railroads, etc., and some have been reserved for the use of the State Belt Line Railroad for its switching operations.

As an adjunct to the docks, the Harbour Commission owns and operates what is known as the Belt Line Railroad, established in 1891, having at present a continuous switching system, adequately equipped, around the whole active front of San Francisco, from the United States Transport Docks on the north and west to Channel St. on the south. The line is about five miles long, laid on the State owned marginal or waterfront street immediately behind the wharves, which is 200 feet wide, and is called the "Embarcadero," a Spanish name signifying place of embarkation.

In order to extend the Belt Line to serve the Government transport docks, and the Exposition grounds, the Harbour Commission early this spring completed a tunnel through Fort Mason Bluff, 1500 feet in length, 17 feet wide, and 22 feet high, of concrete throughout, with a single track, at a cost of \$225,000.

There are four transcontinental railroads which meet at tide water at San Francisco, viz., the Southern Pacific, the Santa Fe, Western Pacific, and the California and North Western, and all connect with the Belt Line, which has spurs running on to nearly all the piers to their outermost ends. For the most part, spurs are on the sides of the piers, but in a few places are down the centre, the

side arrangement being much preferred, as it interferes less with teaming operations.

On certain new piers, wide enough to permit of it, there have recently been placed a surface track along one side and a depressed track on the other side. There are, of course, also certain teaming tracks and storage tracks for convenience in loading and unloading, adjacent to the main line, from which spurs also extend up the city streets that reach the waterfront, serving factories, industries, etc.

The Belt Line employs seven locomotives and maintains a machine shop, round house, and a track laying and repair force of its own.

The Belt Line system, as in Montreal, is used for the transfer of freight from one place to another on the waterfront, and from one railway to another, and from the industries and various railroad yards to the ships alongside the piers, and from the industries to the yards, and vice versa, the Board assuming no risk to cars or their contents while on its rails, it being understood that such risk is assumed by the railroad that owns or controls the cars.

As the City of San Francisco is practically an island, as far as east and west communication is concerned, having to rely exclusively on ferry service, the Belt Line is also connected with car ferry slips constructed for the freight cars ferried from across the San Francisco Bay.

No passengers are carried on the Belt Line.

Being the only harbour to serve a coast line of hundreds of miles, the principal type of business employed is from coasting vessel to ocean liner, followed in importance by the transfer of cargo from vessel to railway cars, and from ocean vessel to warehouse. A recent type develop-

ing very rapidly is that of from ocean vessel to inland carrier serving the Bay, as well as the San Joaquin and Sacramento Rivers which empty into it.

The Harbour is devoid of cranes and other port equipment for the expeditious handling of cargo, which is all loaded and unloaded by the ships' winches. There are, however, two pairs of shear legs owned and operated by private interests, to which the ship must go in order to unload or load heavy parcels.

There are no grain elevators in the Port, but there is ample warehouse accommodation provided adjoining the harbour for the storage of all kinds of commodities.

Facilities for the construction and docking of the largest vessels afloat are provided in this harbour by the Union Iron Works, which operate at Hunter's Point two graving docks having a length of 750 and 483 feet, and at Michigan Street three floating dry docks 210, 271 and 301 feet long.

San Francisco is the only port on the Pacific Coast which enjoys the advantages of a harbour front that is entirely owned and operated by the public, the title of the property being in the State of California.

The harbour affairs are administered by a Board of three Harbour Commissioners, appointed by the Governor of the State for a term of four years, and hold office during his pleasure.

As afore-mentioned, the Board has jurisdiction over the frontage of that portion of the Bay of San Francisco extending in general terms from the Federal Reservation near the Golden Gate around into the Bay to the line between San Francisco and San Mateo counties, except a small waterway penetrating the southern part of the city, known as Channel Street.

The Board constructs and maintains all the wharves, piers and other transshipping facilities and dredges the docks; and enacts regulations concerning the management of the property of the State within the above boundaries. All construction work is done by contract, maintenance and repairs by the harbour day force.

The harbour has been self-supporting since its inception, the first Board of Commissioners having been appointed in 1863. All the cost of construction and maintenance of sea walls, buildings, wharves, etc., as well as all the operating expenses and the principal and interest of all bond issues, are paid out of harbour receipts. The harbour thus pays its own way, not a dollar coming out of the public treasury or taxes.

The advantage of public ownership to the shipping interests is shown by the provision of the law that harbour charges must not exceed the amount necessary to meet operating, repair and construction expenses, and redeem bond issues.

The Harbour Commission pays no taxes of any kind, the property being exempt because of its belonging to the State.

The Police Authority of the Port is vested in the City, station house and quarters for the policemen being provided by the Board on the harbour front.

The City also provides the necessary fire protection, maintaining two excellent fire tugs, one located at each end of the port, so equipped that 20 streams from each may be played at one time, pumping 10,000 gallons per minute. The vessels cost \$130,000 each, and are manned by 14 city firemen, in addition to the crew of 10. The Harbour Commission supplies a fire station and slip for the vessels, which are used solely for the purpose of fire.

All harbour tugs may be requisitioned in case of fire by the Chief of the Fire Department.

There is no semaphore or signal system in the Port, vessels being free to come and go at will.

Pilotage is under the jurisdiction of the Pilot Commissioners, and is compulsory.

Financial.—Since 1911 practically the whole of the \$9,000,000 bond issue authorized by the Legislature of 1909 has been expended in developing the harbour of San Francisco, and in order to provide for the rapid increase in trade expected upon the completion of the Panama Canal a further bond issue of \$10,000,000 was sanctioned in 1913. No part of this latter issue has been as yet sold, but nevertheless it is available for the provision of additional harbour facilities that might possibly be required.

The revenue of the Harbour Board for the year ended June 30th, 1914, is given below:—

Dockage.....	\$229,188.00	
Tolls.....	362,694.80	
Wharfage.....	12,336.36	
Rents.....	670,595.74	
Belt railroad, north.	159,114.00	
Belt railroad, south.	34,879.00	
Miscellaneous.....	50,155.20	
	<hr/>	\$1,518,963.10

ASTORIA.

The Port of Astoria, Oregon, is situated on a peninsula on the south bank of the Columbia River, about 12 miles from its mouth, upon which, with its protecting jetties, \$12,500,000 have been spent by the Government.

The Port is approached by a channel, having a minimum

depth of 30 feet, dredged and maintained by the United States Government, which also provides the necessary lighthouses, beacons and other aids to navigation.

The range of the tide is 12 feet extreme and 6 feet mean, and the river bed is sand.

All of the accommodation in the Port is of the river side quay type, with the exception of the Municipal Dock, to be later described.

Prior to the year 1910, the entire waterfront of the Port was vested in private interests, the extent of accommodation privately owned and operated at present having a wharf frontage of 4,990 feet.

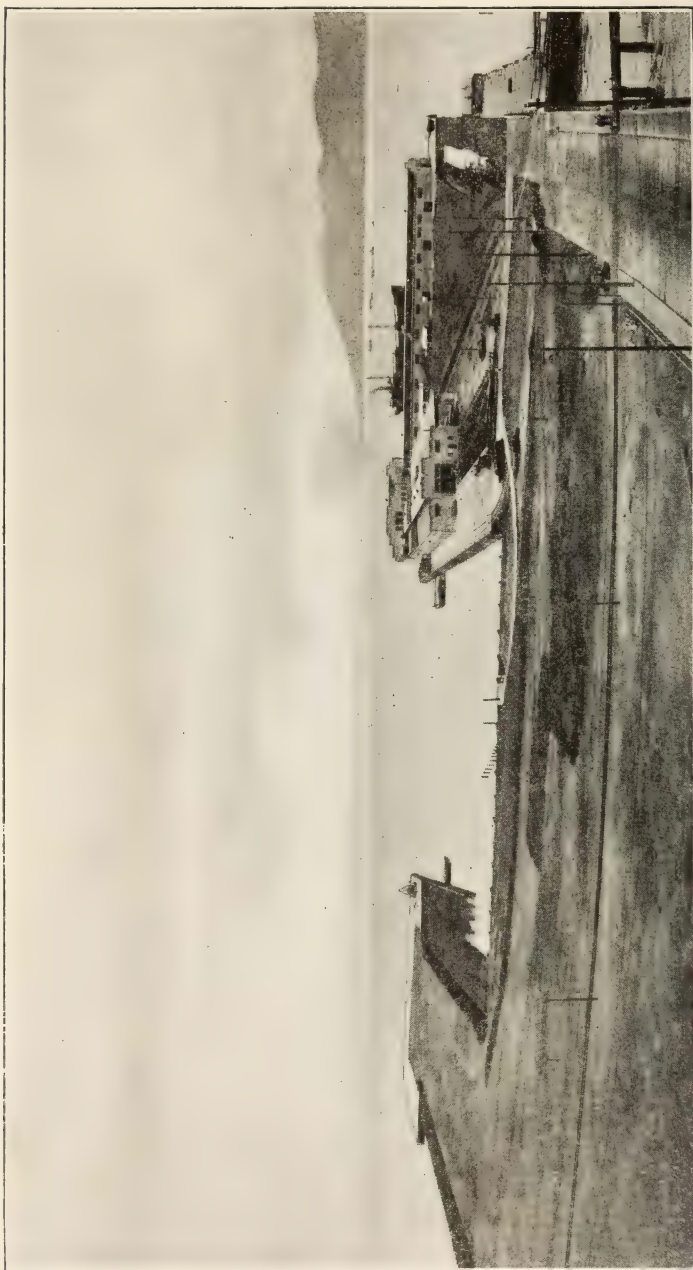
Early this year at Tanzy's Point, on the west side of Young's River Bay, four miles from Astoria, were completed, at a cost of \$250,000, the docks constructed by the Great Northern Pacific Railway to meet the demands of its rail system and its palatial liners, which began operation between Astoria and San Francisco in the month of June, 1915.

The site of the docks embraces about 20 acres of a splendid frontage at the junction of the Columbia River and Young's Bay, and the docks are about one mile long by 800 feet deep.

The terminal site proper contains the yard, depot, docks, warehouses, roundhouse and all the accessories of a great rail and steamship unit of operation, flanked by 21,000 feet of trackage.

The wharf at which the vessels berth is 600 feet long by 80 feet wide, its surface being covered with a magnificent two-storey transit shed, served by an approach channel of 45 feet depth.

Most of the wharves in the Harbour, with the exception of those engaged in the lumber business, are



Port of Astoria—Municipal Docks

covered with sheds, one storey in height, of wooden construction, and are mainly used for the purposes of their owners.

Tramp steamers and other vessels, however, may make arrangements to berth and load and unload cargo at the wharves of the Spokane, Portland & Seattle R.R., the Oregon & Washington R.R., G. W. Sanburn & Co., Harkins Transportation Co., and the Callander Co.'s wharves, by private contract.

There are no graving or floating dry docks in the Port, it being necessary for vessels desiring such accommodation to proceed 100 miles further up the Columbia River to the Port of Portland, where such facilities are available.

Organization and area of Port.—The Port of Astoria held its first meeting in February, 1910, when it was organized in accordance with the Act of the Legislature of 1909. The boundaries of the Port coincide with the boundaries of Clatsop county, giving the Port a frontage on the Columbia River from Westport to Fort Stevens, a distance of about 40 miles.

The Port is administered by five Commissioners, elected by the people of the Port of Astoria for a term of four years, one of whom retires yearly. They elect a President, Vice-President, Secretary and Treasurer from among themselves, and appoint an Engineer and Harbour Master, the latter's duties being chiefly to regulate the movement of vessels in the Port, to assign berths and anchorages, and police the harbour.

The Board has authority to tax the property within the Port to the extent of five mills per annum, and can borrow to the extent of ten per cent of the assessed valuation of the property within the District. Up to the

present, the Authority has borrowed \$550,000 at 5 per cent, but their borrowing limit, according to the present assessed valuation, is \$2,000,000.

The Commission is authorized to improve the Columbia River in the vicinity of Astoria, as well as other rivers and bays within the corporate limits of Astoria, to build docks, transit sheds, channels, coal bunkers and sell coal, and also to build and operate a boat line, a dry dock, and undertake towage and pilotage service to the interior.

After four years of investigation and preliminary work, the Commission sold bonds to the extent of \$550,000 and immediately prepared plans for the construction of a Municipal Dock system. A tract of land of 46 acres, with 1,850 feet of water front, was bought at Smith's Point at a cost of \$51,000, which developed about $1\frac{1}{4}$ miles of waterfront, and on the 3rd June, 1914, work was begun on the foundations of the dock.

The general plan of developing the Port property consisted of two slips and three piers, and already two of the piers and a slip of the following dimensions have been completed and are in active use:—

Pier No. 1 . . . 1,100 feet long . . . 620 feet wide.

Pier No. 2 . . . 1,400 feet long . . . 344 feet wide.

The slip between is 400 feet wide at the river end of the piers, narrowing down to 250 feet at the inshore end.

Pier No. 1 is supplied with two transit sheds, one a building 730 feet long by 90 feet wide on the west side, and the other 532 feet long by the same width on the north side or end. Each shed is divided by four fire walls, built entirely separate and on independent foundations, so constructed that the building on either side may be

destroyed without affecting in any manner the stability of the fire wall.

The walls of the sheds are of tile construction, all openings being covered by steel rolling doors. The roofs are asbestos and the foundations of the buildings are so designed that a second storey may be added at any time, without reinforcing, by merely raising the roof the necessary height.

Excellent passenger and office facilities are provided in a second storey, located at the north end of the freight shed.

A three-rail track is provided in front of the sheds, rails being spaced 4 feet 8 inches apart, it being intended to use the middle rail with either of the other two rails for the handling of cars, which will permit of the placing of the cars either close to the building or on the edge of the wharf. The tracks in the rear consist of a series of short spurs approaching the shed at a very flat angle, each with a capacity of two cars. The tracks are depressed and the platforms extend parallel to each of the tracks, which permits of the unloading of cars from either side.

At the north end of Pier No. 2, coaling facilities are provided, with a storage capacity of 20,000 tons. Coal is loaded to vessels at the rate of 250 tons per hour.

Water and fuel oil pipes are also installed along the face of each of the piers, so that ships may be supplied while receiving or discharging cargo.

The Port Commission has under construction a grain elevator, with a capacity of 100,000 bushels, provision having been made so that this can be increased to 500,000 bushels when the trade necessitates such an addition. The house is built of wood, and most of the grain

handled in the Port is at present received in jute bags.

In addition, the Commission has also constructed a sea wall at a cost of \$54,000, and reclaimed behind the same acres of land at a cost of \$186,000.

In order that the facilities to be provided by the Port at an expenditure in all of \$1,000,000 may be utilized to their fullest extent, the Port has under contemplation the establishment of a boat line to operate between Astoria and Lewiston, to transport the products from the vast area known as the Inland Empire to the mouth of the river, to be loaded there on vessels regardless of whether terminal rates are granted to Astoria by the Railroad or not. The Port is ready to back this movement for one-half of its capital, say \$250,000, the remainder to be subscribed by 2,500 shippers, who would then have an immediate interest in turning their freight to the boat line and the Port of Astoria.

Astoria at present is an exporting Port, the bulk of which originates within the District, and consists principally of lumber and fish.

The population is 15,000, and lumber and salmon packing are the chief industries located adjacent to the Port, as well as a flour mill with a capacity of 500 bbls. daily.

The only railway running to the Port is the Spokane, Portland & Seattle R.R., which has tracks leading to all the wharves and industries.

Fire and police authority is vested in the City of Astoria, although the Port Commission has power to make police regulations for the Port District, which extends beyond the boundaries of the municipality of Astoria, and organize a force for the maintenance of such regulations when the necessity arises.

The property within the Port District belonging to the Port of Astoria is exempt from taxation, but private wharves pay water, municipal, port and state taxes.

PORTLAND.

Portland, Oregon, situated at the head of deep water navigation on the Willamette River, 12 miles above its confluence with the Columbia River, is distant 112 miles from the Pacific Ocean.

The Willamette River divides the city into two sections. The main business district is on the west side, where are located the principal industries and railroad freight and passenger depots and terminal yards. At the present time, the east side is more of a residential district, although most of the wharves and warehouses for deep sea or foreign vessels, large lumbering plants, grain elevators and docks, flour mills, etc., occupy the water front there.

If both banks of the river within the present city limits are included, there is a total water frontage of about 24 miles. Of this, 18 miles are available for deep sea shipping. If the Willamette River from the lower limits of the city to its confluence with the Columbia River is included, the frontage available for deep sea shipping becomes 21 miles, so that greatly increased dockage facilities can be readily supplied when the shipping interests of the Port demand additional berthing space. The frontage mentioned above is based on quay construction, so that the berthing space can be materially increased by piers and slips, of which there are none at the present.

The work of providing the necessary depth to the wharves on this latter frontage is excessive neither in the amount of material to be moved nor as to the cost. The



PORTLAND, OREGON—Harbour View of Municipal Dock No. 1.

material being sand and very little gravel is readily handled by suction dredges, as there is an entire absence of rock or boulders in the harbour channel area.

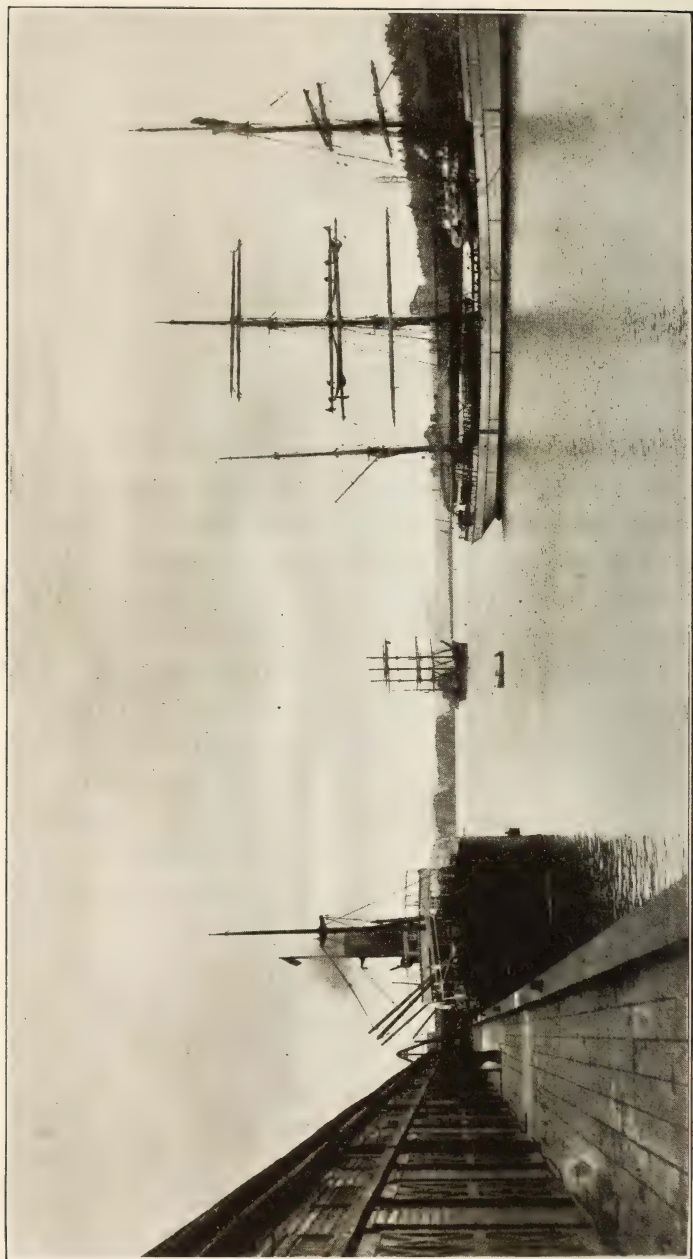
The harbour is of ample width, about 1,500 feet being the minimum distance between harbour lines in that portion of the river used for deep sea shipping, and the Federal Government and the Port of Portland have just completed the deepening of the entire area between the harbour lines to a depth of 30 feet at low water. Steps are now being taken to have a project adopted for a 35 ft. low water channel of ample width.

In 1866, when the improvement of the channel was first undertaken, there were shoal places with but 10 to 12 feet at low water. By dredging and other improvement work done by the Government and the Port of Portland, there is at the present time a low water depth of practically 30 feet in the ship channel of the Columbia and Willamette Rivers from Portland to the Sea, which is marked by the United States Government with a splendid system of buoys, ranges and beacons, making it entirely safe for the movement of shipping day and night.

In the deepening of this channel, the Government operates three dredges and the Port of Portland four, the latest of which has a capacity of 22,000 cubic yards per day of 22 hours.

The River Columbia has been covered with ice for only a day or two in very unusual seasons, and with a very few rare exceptions this great waterway is open to navigation every day of the year.

Owing to the presence of very strong currents and a large area of uncontrolled sand spits, the channel at the entrance of the Columbia River was subject to frequent changes in depth and direction prior to the time the im-



Portland, Oregon, Harbour—Steamer unloading at North Bank Dock (Spokane, Portland & Seattle Railway Co.), and sailing vessels at anchor

provements undertaken there by the Federal Government had become effective. By the construction of a jetty seven miles long on the south side of the entrance, just completed, the partial completion of a north jetty, and by dredging, the channel has been established in a permanent location and direction, and at the present time has a depth of 31 ft. at low water. The approved project now being carried to completion contemplates a low water channel depth of 40 ft., and it is expected at the close of dredging and jetty operations this year there will have been obtained a channel having a low water depth of 36 feet. and width of 2,000 feet.

Portland is so far inland that tidal fluctuation, though perceptible at periods of low water, is negligible, the variation being from 1 to 4 feet, depending on spring or neap tides. On the other hand, it is subject to all the fluctuation of level characteristic of rivers above tidal influence, and the range between extreme high and extreme low water is more than 30 ft.

There has already been developed by private interests a river frontage about 5 miles in length, which is now being used by vessels ranging from river boats to coasters up to the largest ocean-going tramps. The principal wharves have a depth of from 25 to 30 feet, and are owned as follows :—

Railroads.	3,140 ft. of wharf frontage.
Private interests	4,609 “ “ “

In addition to the above facilities, there are lumber docks having a quay frontage of 7,772 ft., and many others used exclusively for river craft, sand and gravel business and industrial purposes.

Ninety per cent of the wharves in the harbour are

connected with rail transportation, and with their derricks and conveyors can unload readily from car to vessel and vice versa.

In addition also to the above wharves, the City of Portland, having voted a bond issue of \$2,500,000 in 1912, own and operate, under the control of the Commission of Public Docks, the following, all of which have been constructed since 1913 :—

Municipal Dock No. 1.—This dock is designed for coastwise and ocean vessels of the largest type entering Portland, provision being made for the convenient handling of freight from and to river crafts, whose importance is recognized as mediums at all docks for the assembling of outbound freight and for the distributing of cargoes received from ocean carriers.

Therefore, of the 955 ft. front, some 655 ft. of this dock is single level, with the deck surface placed at an elevation of 32 ft. above mean low water. The southerly 300 feet is a two level dock, the upper level at 32 ft., the low level at 18 ft. above mean low water. A high level dock of 955 ft. in length is thus provided for large steamers, with a width of 122 feet, yet providing berthing space for one or two river boats.

This dock is equipped with a transit shed, one storey, 100 ft. in width by 935 ft. in length.

The superstructure of the dock is of heavy mill construction, supported on wooden piles. At the rear of the dock a concrete bulkhead wall is provided the full length of the structure, to retain the fill placed between the dock and the first parallel street. This wall extends from elevation five feet above low water to the height of the upper level of the dock, a wall about 26 feet in height.

At each end of the dock there is a reinforced concrete fire wall, extending from about low water to a height of six feet above the rake of the shed roof. The end fire walls are provided to protect the dock structure against fire on adjacent docks, both as to the substructure and the superstructure. In addition to the end fire walls, fire stops, extending from low water to the under side of the dock floor, are provided at intervals as retardents against the sweep of fire underneath the docks, and on the face of the dock a three-inch planking, laid with four inch spaces, from low water to the top of the dock, protects the structure from fire from the front.

Double thickness of tongued and grooved flooring is used in all floor constructions, and where the dock is two-level the upper floor is waterproofed, using two layers of building paper, well swabbed with asphalt, between the two layers of flooring, to prevent damage to goods on the lower floor from leakage caused by the sprinkler system and from other causes incident to dock operation.

The sides of the dock sheds are covered with asbestos protected metal, and the transit sheds provided with sprinklers and other efficient fire protection facilities. Steel roller doors, steel sash with wire glass, and four-ply asbestos roof are the standard for all dock construction. Due to this nearly fire proof construction, the City enjoys a very low insurance rate, viz., 69 cts. on the shed and 81 cts. on the cargo.

The dock is equipped with cargo masts or cargo hoists, which are constantly used in loading and discharging ships, either entirely in connection with the ship's gear or by a combination of ship's gear and electric dock winches, of which four are in operation at this dock, with a rated capacity of 31 horsepower, operated with direct current.

Provision is made for "plugging in" the dock winches at every door opening on the river side of the dock.

In the two-level section there is installed a three-ton electric elevator, with platform 8 x 14 feet.

At the end of the shed is a slip 120 ft. in width by 484 ft. in length, with an open dock 60 ft. in width, along which is at present being erected a one-story transit shed in the rear, 175 ft. in width by 330 ft. in length.

A one-story warehouse, 190 ft. in width by 200 ft. in length, is also built in the rear of Dock No. 1, connected with the dock by electric conveyors.

Municipal Dock No. 2.—A quay dock 124 ft. in width by 526 ft. in length, two-level with one-story transit shed 100 ft. in width by 526 ft. in length.

This dock is of absolutely the same construction throughout as Dock No. 1, except that a departure was adopted in the construction of the floor of the low level. It consists of a reinforced concrete slab, supported on creosoted timbers. As the elevation of the lower deck is only 18 ft. above low water, it is, at times, subject to overflow, and in this respect the concrete floor should have a distinct advantage over the customary wooden floor.

This dock is equipped with electric winches and dock autos of a capacity of three tons.

Municipal Dock No. 3.—A quay dock 120 ft. in width by 540 ft. in length, 50 ft. of which is two-level. Transit shed, one-story, 100 ft. in width by 440 ft. in length.

Motor Boat Landing and Recreation Pier is of fire-proof construction, and is provided with a convenient landing place for motor boats and has two enclosed rooms, each 24 x 26, to serve as recreation and waiting rooms. On top of this structure the Commission is now erecting its permanent offices.

The City also owns a portion of the Public Levee lying on the west side of the river, with a frontage on the harbour line, including street ends, of 640 ft., and an average depth of 120 ft.

The total amount of money expended to date in the construction of the above municipally owned facilities is \$1,050,000, and including property purchased \$2,400,000, leaving only \$100,000 of the \$2,500,000 bond issue for future constructions.

The Commission of Public Docks at present have a most comprehensive plan for the future development of the Port, which will provide for an installation of piers, slips, quays and warehouses on property known as "Bridgeport" and "Mock's Bottom"; also the acquisition of Swan Island and the removal thereof, and the development of "Bridgeport" and "Mock's Bottom" properties. This comprehensive plan, it is estimated, will require an expenditure of \$14,475,000, and will furnish berthing space at one time for 38 vessels of 500 ft. each in length, with classification, assembling and storage railroad yards accommodating 780 cars. Industrial sections in the rear of the warehouses will contain about 180 acres for factory development.

The Port of Portland has a floating dry dock, five pontoons, with a capacity of 10,000 tons, length 468 ft., inside width 82 ft., depth of water over keel blocks 25 ft.

The Oregon Dry Dock Co. owns and operates a floating dock having a length of 340 ft., a width of 60 ft., and a depth over keel blocks of 18 ft., deadweight capacity, 3,500 tons.

The inland waterways tributary to Portland are practically all situated above the mouth of the Willamette River and drain an area within the states of Oregon,

Washington, Idaho and Montana of about 200,000 sq. miles.

The Willamette River is navigable above Portland for 171 miles during favourable stages, and for a distance of 83 miles at nearly all stages.

In common parlance, the Willamette is spoken of as flowing northward. In the summer season this stream is practically a backwater from the Columbia River; in the winter and spring seasons the Willamette is a natural river, fed from the mountain streams and snows.

The traffic of the Columbia and Willamette Rivers is—down-river—wheat, flour, lumber, cattle, wool, fish; the up-river—general merchandise, machinery, railroad supplies and coal.

The Port is served by the Union Pacific, Southern Pacific, Northern Pacific, Great Northern, and through connections, the Burlington Railway Systems and by several interurban electric lines traversing rich agricultural districts.

While there is no belt line in operation in the Port at present, the foundation for one has been laid by the Commission. In all franchises for the construction of new rail facilities within the city limits, a provision has been incorporated providing for common use on such tracks by all railroads and the City, and it is expected that within the next year or two a municipal line will be in operation on both sides of the river, connecting Municipal Docks Nos. 1 and 2. At present on the west side of the river a terminal company, composed of the different railway lines on that side, switch the cars to the different docks, on equal terms.

Type of Port Business.—There is no lighterage system in the harbour of Portland, and the greater portion of the

cargo is for local distribution, only about 22 per cent being for transshipment. Motor trucks are used extensively in the carrying of the cargo from the docks to destination.

A 35-ton stationary crane, a 20-ton portable crane on rails, and two coal bunkers of 12,000 and 6,000 tons capacity complete the equipment of the Port.

There is no signal system in operation in the Port, although the river is narrow, as compared with Montreal and the St. Lawrence, and occasional fogs occur.

Administration.—While wonderful work has been done by the different authorities in the creating of a ship channel to Portland, nature being very deficient in this regard, the system of port management does not seem to be as satisfactory as it might be, because of the diversity or multiplicity of authority existent in the Port.

The river front ceded to the City originally passed years ago into the hands of private interests, principally the railroads, who, up to 1913, were responsible for the entire development of the Port.

The "Port of Portland," created in 1891, was not authorized to improve the port facilities, but to improve the Willamette and Columbia Rivers between Portland and the sea, and create a ship channel of sufficient depth, to erect and operate a dry dock, to maintain a towage service, to furnish coal and supplies to ships and to dredge Oregon Slough. This Commission is composed of seven members, the President, Vice-President, Secretary and Treasurer being elected from among their number. The functions of this body, as is evident, are those of the Government, viz., channel improvement.

In order to develop the Port, however, another body, the "Commission of Public Docks," was organized, with

five members, appointed by the Mayor, which body has jurisdiction between the pierhead line and the bulkhead line, and control of the character of the structures to be built within that area, whether by private, railroad or other interests.

Pilotage is under the State Pilots' Association.

It seems that a consolidated port commission should be established to look after both the development of the Port and the channel, which commission should have comprehensive jurisdiction.

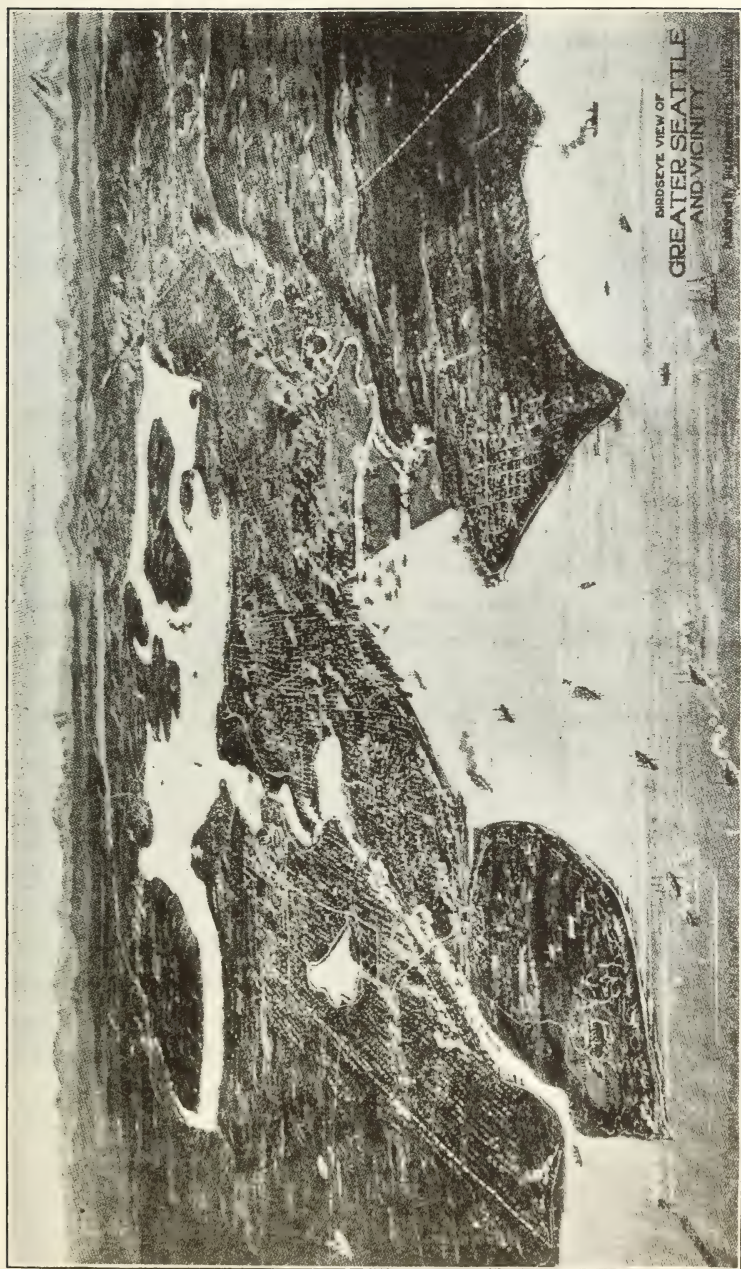
On the ship channel from Portland to the sea there has been expended \$7,000,000, \$3,000,000 by the Government and \$4,000,000 by the Port of Portland, and to improve the mouth of the Columbia River the Government has to date expended approximately \$12,500,000.

Lying in the heart of a great territory producing a wealth of raw materials, with a fresh water harbour that needs but little improvement to put it in first rank, Portland, with her tonnage increasing with every passing season and her new railroads into the interior adding to the volume of products brought for shipment, is destined to become a great transshipping and distributing centre. The possibilities of her situation are enormous and such as will survive all competition.

SEATTLE.

The Port of Seattle, Washington, is situated on and practically covers the entire shore of Elliott Bay, an inlet on the eastern shore of Puget Sound. Between its extreme limits, West Point and Alkali Point, the pierhead line is about 10 miles long.

The really practical limits of the Harbour, as far as



SEATTLE.—Bird's-eye view, showing tidal outer harbour and non-tidal inner harbour.

the present is concerned, may better be taken as Duwamish Head and the southern point of Magnolia Bluff, directly opposite. Within the line joining these points is Elliott Bay proper, quite similar in contour to Commencement Bay, on which the Port of Tacoma is situated, 30 miles south of Seattle.

The area of Elliott Bay, as thus outlined, is 4.3 square miles, and its pierhead shore line, not counting slips and waterways, is $6\frac{1}{2}$ miles. Over this area there is ample depth for the heaviest shipping, and there is never any ice or rough weather to disturb deep sea vessels. The depths in the Bay, however, are very great, and preclude anchorage except at a few places inshore. The area of shallower water permitting the construction of modern long piers is found principally at the south end of the bay. The waterfront first developed by private enterprise and naturally called upon to serve the principal harbour needs of the city, is now the congested crescent lying between Pike Street on the north and Connecticut Street on the south.

At the north is the important pier of the Great Northern Railway, and near it Smith's Cove, one mile long by 400 feet wide.

On the south side of the harbour, the delta of the Duwamish River has been filled in except for the reservation of two waterways, the East Waterway and the West Waterway, including a tract of land popularly known as Harbour Island, from which great things are expected. When finally completed, East Waterway will be practically a slip a mile long by 1,000 feet wide, with slips and quays on the two sides. The east side of the Waterway is really a part of the main waterfront. West Waterway is 900 feet wide and the outlet of the Duwamish River, the

channels in both waterways being dredged to 30 feet at low tide.

The valley of the Duwamish furnishes the single large tract of bottom land directly adjacent to the harbour, and it must naturally develop into an important industrial centre.

Such is what may be termed Seattle's outer, or tidal harbour, with a perimeter, including the three main waterways, of $12\frac{1}{2}$ miles east of Magnolia Bluff and Duwamish Head, and this is susceptible of almost indefinite extension by pier and slip construction.

At the present time there are about 22 piers, with a total lineal frontage of about 48,000 feet, that are privately owned.

There is also a municipal dock at the foot of Harrison Street with a gridiron, intended for small vessels and where heavy materials can be loaded or unloaded from barges.

For the accommodation of the general public, the City maintains three small boat landings, by the use of pontoon floats, with suitable gangways leading up to Railroad Avenue at the foot of streets.

There are also eight steel mooring buoys.

Prior to 1912, the Harbour of Seattle was practically owned and developeed by private interests. The tide lands had been sold, and even the so-called harbour areas, though still belonging to the State, were so tied up by preferential rights to the abutting lands as to give the upland owner full control for 30 years.

In order to make provision for a large increase in water commerce, incident to the completion of the Panama Canal, the federal railroad construction in Alaska, and the growing deep sea commerce the world over, on the 5th September, 1911, was created, by vote of the people of

King County, the Port of Seattle Commission, the only port organization of its kind to be found in the United States, inasmuch as it is not part of the State Government, except that it exists under a general statute. It is not part of the City, County or other body previously existing, but is an independent municipality, known as the Port of Seattle District, the governing body of which is the Port Commission, consisting of three members elected for terms of three years, so arranged that one Commissioner retires every year, precluding sudden changes in port policy.

The Port District Act gives the Port very extensive powers—in fact, all that are necessary to the full performance of its work, except that the police and fire authority is vested in the City of Seattle.

The Commission has authority to levy a direct tax on the property of the district not exceeding 2 mills in any one year, and it can issue bonds on the credit of the District not to exceed 3 per cent of the assessed valuation. To date the bonds voted amount to \$6,300,000, and the bond limit is \$7,500,000.

Since its inception, the Commission has carried out the following developments:—

Smith's Cove Terminal.

This terminal is located at the north side of Elliott Bay, and consists of a great pier 310 feet wide by approximately 1,700 feet in length, and planned to be ultimately extended to a length of 2,530 feet. The central portion of the pier is filled, on the sides creosoted pile wharves being built over rock riprap slopes. Depressed tracks and a driveway are located through the centre of the pier. At the outer end on each side there is a mer-

chandise shed 600 feet long by 96 feet wide, connected by an end shed 160 feet in width. The pier was designed, however, primarily for the handling of heavy commodities, such as lumber, rails, structural materials, etc., for which reason the major portion is an open wharf. Tall fire monitors or towers in the middle of the pier give fire protection.

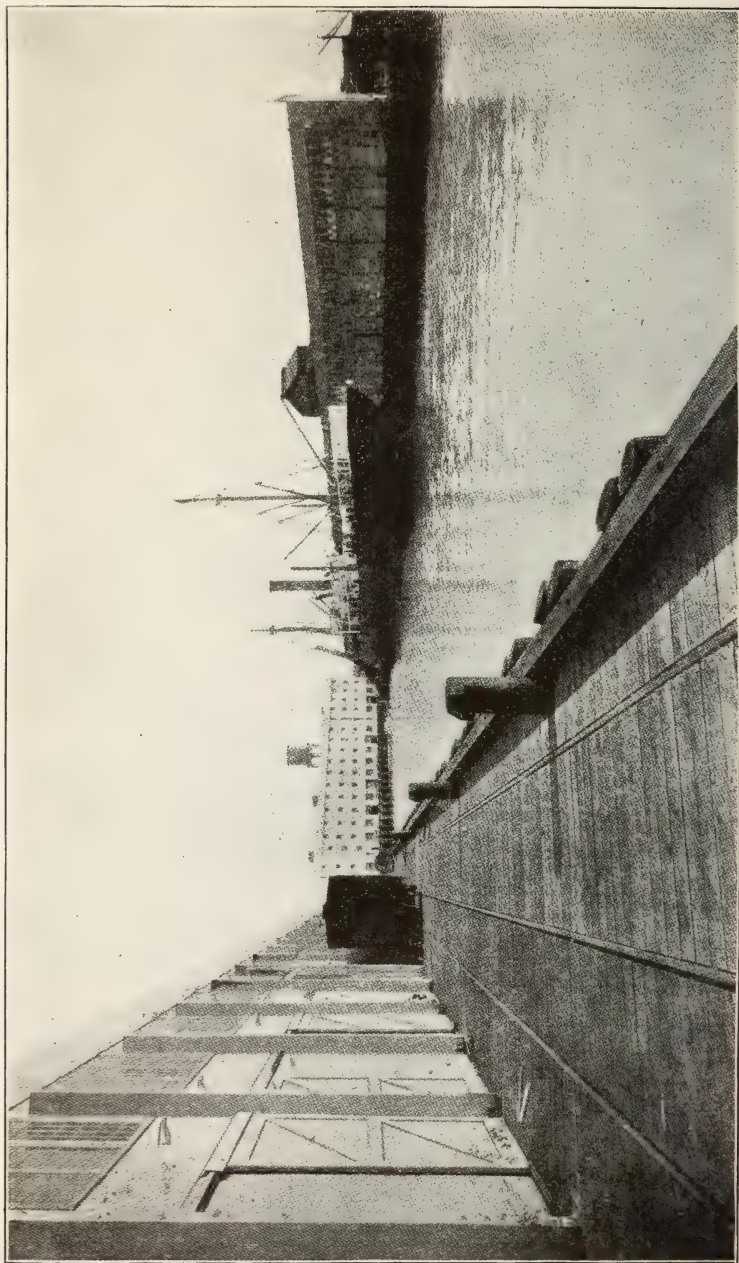
A big gantry crane, a 15-ton locomotive crane, which performs the necessary switching on the pier, and a 100-ton shear legs complete the equipment provided.

Bell Street Terminal.

This terminal consists of a wharf, with nearly 1,200 feet deep water frontage, equipped with a two-storey transit shed, 800 feet long by 70 feet wide, which is provided with three Barlow marine elevators, so arranged as to be lowered to the water's edge at any stage of the tide. Two of these elevators have a lifting capacity of 10 tons each, and are approximately 12 x 35 feet. The wharf is also furnished with moveable dock winches.

Back of the transit shed is a reinforced concrete warehouse, 422 feet long and 80 feet wide. The north 100 feet constitutes a cold storage plant of five floors. Three floors of the south 300 feet comprise the ordinary warehouse section, and about 30 modern offices occupy the fourth floor, the headquarters of the Port Commission.

The roof of the building is used as a public waterfront observatory and playground, and is equipped with cement floor, cement balustrade, globe lights, and a very attractive shelter house. This plant is within convenient reach of the public markets and wholesale houses, and serves with efficiency the growing needs of local producers and consumers.



SEATTLE—Public Slip between Stacy and Lander Streets, flanked by wharves. Concrete storage warehouse at end of slip.

Stacy-Lander Terminal.

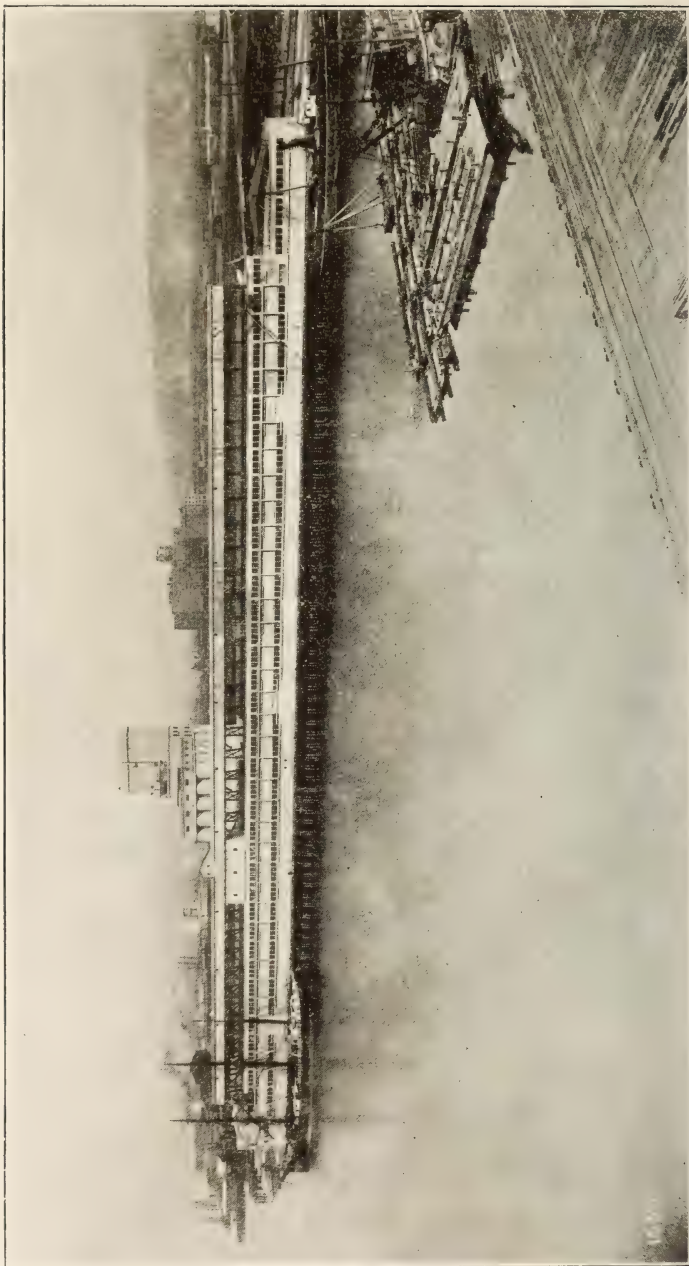
What is known as the East Waterway improvement comprises the Stacy and Lander Street wharves and the Whatcom Avenue warehouse. This improvement covers nearly all of a block of about eight acres in area on the east side of the East Waterway. The ground was purchased for about \$50,000 per acre. Through the centre of the block has been excavated a slip of about 32 feet at extreme low tide. On each side of the slip is located a wharf and freight shed, while on the east side of the slip is a wharf backed by the Whatcom Ave. warehouse. The superstructures are carried on creosoted piles. The two freight sheds are 90 feet in width and 750 feet long, single storey, with the roof carried on trusses spanning the full width so that the floors are unobstructed by columns.

The Whatcom Ave. warehouse is a modern, reinforced concrete fireproof building, four storeys in height, each floor having a storage space of about half an acre. Provision has been made for handling freight within the warehouse by the installation of three electric elevators, two spiral chutes, one electric vertical conveyor and portable electric trucks and trailers. One electric elevator is located at each end of the building, and the spiral chutes convey freight from any of the upper floors to the loading platforms at the two ends of the buildings. The building is equipped throughout with an automatic sprinkler system.

On account of the demand for space in this public warehouse, the Commission has directed its enlargement to increase its capacity about 85 per cent.

Hanford Street Terminal.

The Hanford Street Wharf is located on East Waterway, in close proximity to the railroad yards, the flour



SEATTLE—View of Hanford Street Wharf and Concrete Grain Elevator in rear.

mills and the large manufacturing plants, and is covered with a two-storey transit shed, of timber construction with galvanized iron covering. The floors are of double plank construction, with an asphalt driveway 20 feet wide down the centre. The shed has a length of 1,278 feet, a width of 90 feet, each storey having a 20 feet ceiling.

The berthing space at this terminal is 1,000 feet on the south side, and 479 feet on the west side, with water depth of 35 feet at extreme low tide. The slip is V shaped, 180 feet wide at the east end and 900 feet wide at the west end, between the Hanford Street Wharf and the Spokane Street Wharf.

Back of the above wharf is situated the first bulk Grain Elevator in the United States, built, owned and operated by the public, with a capacity of 500,000 bushels. The building is of reinforced concrete, and consists of 25 circular bins of 15,000 bushels each, 16 interstice bins of 3,600 bushels each, and 32 workhouse bins, and ships grain over a modern conveyor system to vessels at the rate of 20,000 bushels per hour, conveyor galleries being located on top of the transit shed.

Spokane Street Terminal.

This development, at present under construction, consists of a wharf eventually 1,000 feet long, with a two-storey transit shed 600 feet long by 90 feet wide, in rear of which is being erected a seven-storey reinforced concrete, sprinkler protected public fruit storage warehouse, for the accommodation primarily of apples from the Inland Empire for shipment to Australia, Atlantic Coast Cities, Great Britain and Continental Europe.

Provision for the storage of 2,000,000 lbs. of fresh halibut is also made in this warehouse.

Salmon Bay.

In this Bay the Port owns 36 acres, a very valuable tract on account of its wonderful position from a transportation point of view, being located just above the Lake Washington Canal Locks. While the tract will eventually be developed into an extensive terminal proposition, for the present a small portion of the same is being improved for the use of the Puget Sound fishing fleet, a net warehouse and headquarters building and a marine railway having been constructed, as well as bulkheads, slips and mooring floats. The establishment of such facilities for the fishing fleet, at present scattered up and down the Sound, is expected to concentrate the fleet in the Bay, \$150,000 being spent by it annually in outfitting their boats and buying provisions for their trips.

Public Ferries.

The Port Commission also operates the ferry services on Elliott Bay and Lake Washington, having constructed for the latter, at a cost of \$90,000, the ferry "Leschi," with a steel hull and wooden superstructure, a speed of 13 miles per hour, and a carrying capacity of 30 vehicles and 1,000 passengers, there being seating capacity in the main cabin for 275.

The several projects outlined will cost the Commission \$6,250,000 when completed, over \$1,500,000 being spent in purchasing land, which would have been entirely unnecessary if the beneficent purpose of the founders of the Commonwealth to retain public ownership of the waterfrontage of its harbour had prevailed.

Seattle's development consists of piers in the Harbour proper and quays on the East and West Waterways, and the types of port business employed are principally from

ocean and coasting vessels to railway cars, and from vessels to warehouses.

The extreme fall and rise of the tide is 17 feet.

Dry Docks.

Although the Port Authority does not own or operate any dry docks, there exists in the Port one of the largest shipyards on the Pacific Coast, with facilities and capacity for building anything from battleships to torpedo boats, and from ocean liners to the smallest inland passenger steamers and freighters.

The Seattle Construction & Dry Dock Co. has three floating dry docks, viz.:—

No. 2.—Wooden floating dry dock, lifting capacity 3,000 tons. No. 3.—Steel tower, sectional dry dock, lifting capacity 12,000 tons. No. 4.—Wooden floating dry dock, lifting capacity 7,500 tons.

The Elliott Bay Dry Dock Co. operates a small floating dry dock, 100 feet by 50 feet, with a lifting capacity of 400 tons.

On the west shore of the Sound, directly opposite Seattle, is located the Naval Station of the North Pacific Coast, in connection with which the United States maintains two large dry docks of the modern type, as follows:—

The oldest dock is 650 feet long and 90 feet 6 inches wide, large enough to accommodate the largest ships now on the Pacific Coast.

The new dock, opened early in 1913, is a first-class stone dry dock, 820 feet in length and 110 feet in width.

So great has been the demand for accommodation at these docks that the Government has now under contemplation the construction of a third and larger dock. The Government does not solicit business, but accom-

modates merchant ships when the docks are not in use by its own vessels.

Grain Elevators.

In addition to the grain elevator owned and operated by the Port Commission, already mentioned, there are two on the shore of Elliott Bay, one belonging to the Great Northern Railway at Smith's Cove, with a capacity of 350,000 bushels, and the other belonging to the Northern Pacific Railway at West Seattle, with a capacity of 425,000 bushels.

Up to the present practically all the grain handled from Puget Sound is sacked. It is felt, however, that this is only a temporary condition and on account of the saving which can be made by handling the grain from the fields to the ship without sacking, it is only a question of time until practically all of the grain shipped from the Pacific Coast will be handled in bulk.

There are also four coal bunkers in the Port.

Railway Facilities.

At present there is no terminal railway belt line owned and operated by the Port Commission, the piers of the waterfront being served by railroad spurs connecting with the switching yards and main lines of the different transcontinental railroads. The following are the lines reaching Seattle Harbour:—

Northern Pacific, Great Northern, Columbia & Puget Sound, Chicago, Milwaukee & St. Paul, Oregon-Washington R.R.

Practically the entire waterfront is already served by railways, but the system of operation is very unsatisfactory, due to separate ownership by different lines of

different parts of waterfront trackage, and consequent duplication of charges.

As a beginning, the Port Commission has laid spur tracks on all Port District wharves and piers, giving all railroads access to such "docks" without extra switching charge, providing the "common user" franchise exists on the adjacent street. The Commission has also completed its plans for the immediate construction of the first unit of the public belt line, which unit will extend from the south line of Spokane Street at the Turning Basin of the East Waterway and run northward along Whatcom Avenue to Connecticut Street. This unit will connect up the public elevator, Hanford Street public wharf, Spokane Street fruit warehouse, Spokane Street public wharf, the fish cold storage plant, the Stacy Street public wharf, Lander Street public wharf, and Whatcom Avenue public warehouse with the new public belt tracks, and enable cars from any point to be switched to or from the main lines of the N.P. and G.N. Railways, which have so far failed to extend their running privileges to the public properties mentioned. At present these terminals are served by only the Milwaukee and by the Oregon-Washington Railways. It is also contemplated to extend this unit along the East Marginal Way parallel to the Duwamish Waterway, where is located the most valuable factory and industrial district adjacent to Seattle.

The principal exports from Seattle, which has a population of 312,000, are lumber, grain, flour, fish, raw cotton and coal, in the order mentioned. 100,000 tons of fisheries products are handled annually through the Port.

The revenue of the Port District, aside from direct taxation, is derived from rents and receipts from operation.

Pilotage is not compulsory in the District of Puget

Sound, nor is there any definite pilotage cruising grounds as in other ports. Foreign vessels, however, usually take pilots at Port Townsend.

There are no sheds belonging to the Port District rented to steamship companies, all of them being operated by the Commission itself, as well as their grain elevator and warehouses.

The Port District pays no taxes whatsoever, except that for water furnished by the municipality.

In addition to the harbour facilities above described, Seattle has what may be termed an "Inner Harbour," fresh water, soon to be opened to the commerce of the seas, made possible through the construction of the Lake Washington Canal, which connects Lake Union and Lake Washington with the tidal harbour, and makes available for shipping a great fresh water basin with approximately 100 miles of waterfront. As the elevation of Lake Union is approximately 8 ft. and Lake Washington 16 feet above sea level, it has long been considered by the citizens of Seattle as feasible and desirable that the two lakes be connected with Puget Sound. Nature, by placing Salmon Bay and Lake Union in close proximity, nearly provided the canal, and what was left undone is now being completed by the United States Engineers Department, by funds contributed jointly by the United States Government and by King County. The locks are being constructed at the narrow entrance to Salmon Bay and are two in number, placed side by side. The large lock is 80 feet wide by 825 feet in length, inside dimensions, and the small lock is 30 feet wide by 150 feet long, with 36 and 16 feet draft respectively. The lakes are free from obstructions and do not freeze, and the fluctuation of level will not exceed two feet.

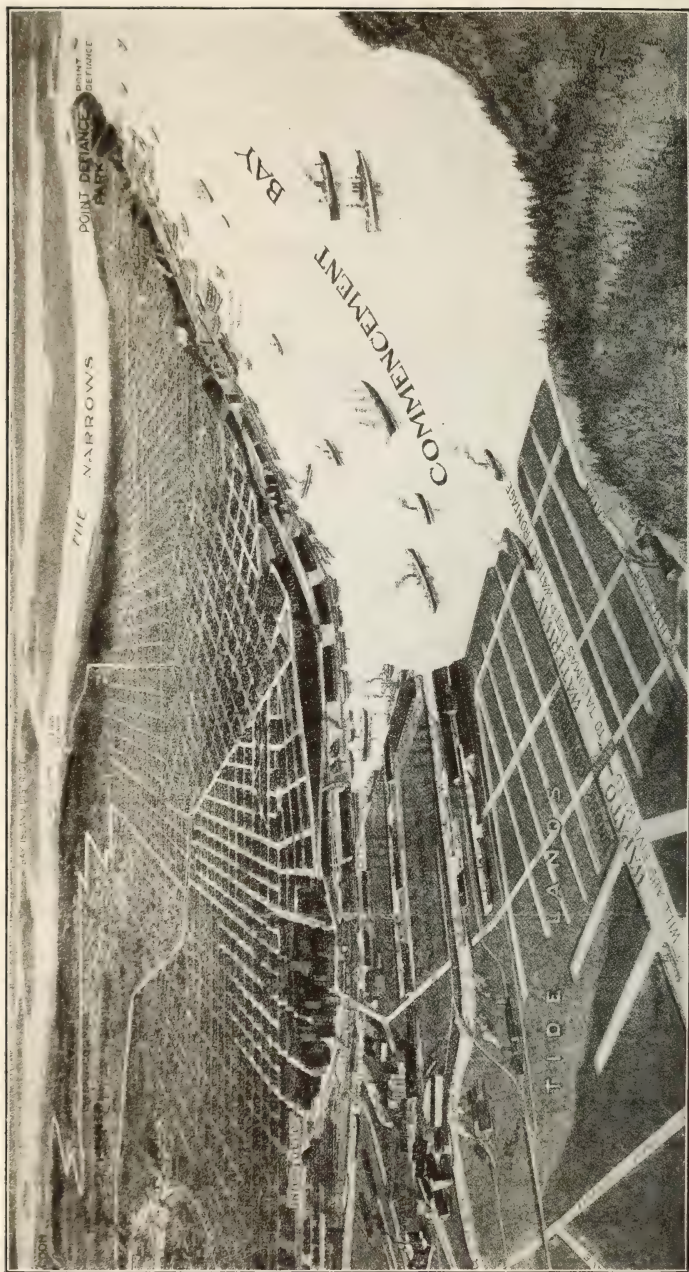
The development of this inner harbour will have cost, when completed, exclusive of bridges and other crossings, approximately \$4,250,000, of which the Government will have contributed \$2,750,000 and local agencies (State and County), about \$1,500,000.

Salmon Bay and Lake Union will, without doubt, become great docks in the very heart of the city, while Lake Washington will offer thousands of acres of shore lands adapted to manufacturing.

TACOMA.

Tacoma, Washington, the second port of importance on Puget Sound, with a population of nearly 100,000 people, is situated on the southern and southwestern shores of Commencement Bay, an arm of the Sound, about 30 miles south of Seattle. The Harbour may be said to include all of Commencement Bay, which is two and one-half miles long and has an average width of nearly two miles. The waters of the Bay are deep throughout, ranging from 50 fathoms at the entrance to 25 and 30 fathoms at the head, where the rise to the flats is very abrupt. The Bay is easy of access and free from dangers.

The principal waterfront is on the southwestern shore of the Bay. At the southern end where the Puyallup River enters there are extensive tidal flats in which a number of waterways, or channels, have been constructed. These flats have been formed from deposits of silt and sand brought down through ages past by the Puyallup River. The channels, the City Waterway and the Puyallup Waterway have been excavated through these flats and a considerable length of waterfront has thereby been added. An attempt was made to extend a navigable



TACOMA—Bird's-eye view of the Harbour and vicinity.

channel up the Puyallup River, but this was unsuccessful because of excessive deposits of silt. During the work of improvement the White River had, through natural causes, been diverted from its former outlet, the Duwamish River, to the Puyallup.

Tacoma is served by four great transcontinental railroads, giving it main line connections with practically every great distributing or producing centre in the United States. For 35 years it remained the terminus of but one road, the Northern Pacific. The Chicago, Milwaukee & St. Paul, the Great Northern and the Oregon-Washington R.R. & Navigation Co. subsequently pushed their lines into the Port. To these railroads are certainly due Tacoma's development.

There is no marginal or belt line railroad along the waterfront, the only connection between the several lines consisting of switches; nor is the harbour generally co-ordinated by any local railway-water system.

Extent and ownership of waterfront.—It has been estimated that 22 miles of waterfront are available at the Port of Tacoma, not including 4 miles which are outside of the limits of the city. The city owns nearly 4 miles in addition to the street ends on the waterfront. The remainder of the frontage is owned by the several railroad companies, manufacturing establishments and private individuals, upon all of whom the port has heretofore depended almost entirely for its port facilities. Not more than one-third of the privately-owned frontage has as yet been developed for commercial purposes. Twelve miles more are being developed, artificially, by waterway construction, and provision made for a total of 40 miles, when future business demands. This indicates great possibilities, not only for the port's future,

commercially, but as well for her industrial opportunity.

The present improved frontage lies on the west side of the Bay and along the City Waterway, Middle Waterway, Puyallup Waterway and the slip excavated by the Chicago, Milwaukee & St. Paul Railway Co.

The extreme tidal range is about 18 feet; ordinary high tide reaches a level of about 14 feet above ordinary low water.

Lighthouses, beacons, etc., are provided and maintained by the United States Government.

Terminals.—The City of Tacoma owns and operate two modern docks, known respectively as the Municipal Dock and the City Dock. The Municipal Dock has a frontage of 500 feet along the waterfront and a width of 170 feet. It is provided with a warehouse of frame construction and has one railroad track along the shore side. The dock building is considered only temporary; in fact, the drawings have been made for an eight-storey reinforced concrete building so designed as to have four entrances from the heart of the city to different floors in the dock above ground level.

The City Dock has a frontage of 300 feet and is 175 feet wide, with track facilities. It is used principally by the mosquito fleet. Buildings on this wharf are leased mostly to commission men.

In addition to the frontage occupied by these wharves, the City owns 800 feet of wharf fronting on City Waterway, and 300 feet on Middle Waterway that are leased to industrial companies.

The City-owned docks are only passenger and package freight stations,—not for the handling of deep water vessels and the general transportation of products, but rather to accommodate the travelling public. Ocean

and coastwise vessels berth at the wharves owned and operated by the Railroads and other private interests.

The waterfront holdings of the Northern Pacific Railway Co. include 2,100 feet of wharf extending north from the foot of South Second Street, upon which have been erected 4,630 feet of shed frontage.

The principal terminal of the Chicago, Milwaukee & St. Paul R.R., known as the Oriental Dock, was created about six years ago, and is but the first unit of a development being made to care for the increasing trade between and through Tacoma and the Far East. This dock is located on the west side of the waterway, which is 2,000 feet long, 215 feet wide, and 35 feet deep at mean low water. The dock proper extends 940 feet along the channel and is 175 feet wide, and is covered by a one-storey wharf shed. Two tracks on the water side and four tracks on the land side run the full length of the dock, and, in addition, a depressed track extends through the centre of the dock for a distance of 440 feet.

Beyond Oriental Dock are a platform or open wharf, 360 feet long, a lumber dock and a car ferry transfer slip.

The Chicago, Milwaukee & St. Paul R.R. also owns a grain elevator which is operated by Leitch Warehouse & Grain Co. This elevator occupies a water frontage of about 1,100 feet, and has a storage capacity of 106,000 bushels of bulk grain and 994,000 bushels of sacked grain. It has equipment for loading grain at the rate of 7,000 bushels per hour.

In addition to the railway terminals used for handling grain, there are several that are owned by private companies.

A number of wharves are owned and occupied by



Steamers loading at Tacoma's one-mile-long Wheat Warehouses.

lumber and industrial companies, but no data in regard to their dimensions was obtained.

The prevailing type of wharf construction is that of pile and timber bulkheads, and quays all lying parallel to the water front. As in most of the other Pacific Coast ports, the teredo is active at Tacoma, requiring that all piles be creosoted.

As almost all of the wharves in the Port are owned by the Railroads, the greater part of the business is handled from ocean or coastwise ship to railway cars direct, the wharves being equipped in almost every case with railway tracks laid between the ship and shed. Only a very small amount of the carrying trade is by vehicle to warehouse.

Dry Dock.—There are no dry docks in the Port of Tacoma, although the provision of one is being urged by those interested, several sites at Chamber's Creek, near Steilacoom, at Quartermaster's Harbour, and near Dash Point or Brown's Point, being available for the construction of the same.

Port Administration.—The Port is under the control of the Municipality. The construction, maintenance, and operation of the Municipal Docks are controlled by the Department of Public Works, while the enforcement of harbour regulations is in the hands of a harbour master, who is an official of the Department of Public Affairs.

Directly in charge of the Municipal Docks is the Superintendent of Docks, who is appointed by the Commission of Public Works and is assisted by ten employees.

Funds for harbour improvement and dock construction are provided by issue of bonds or by appropriation made by the City Council from the general funds of the city. The net income from the municipal docks is placed

in a sinking fund to retire harbour improvement bonds.

The city has power to purchase, but apparently not to acquire by condemnation, property for water terminals and to operate terminal facilities, such as warehouses, railroads, etc.

The fire and police authority of the Port is vested in the City of Tacoma, although the railroads maintain special guardians for their own wharves, etc.

There is no semaphore or signal system in the Port, vessels being free to arrive and depart at will.

Plans for future.—At Tacoma the people are aroused to an appreciation of their situation and of the steps to be taken if they desire to see the Port become increasingly important among the ports of the country.

Plans, upon which work has already been commenced, contemplate a canal system, called the "Wapato-Hylebos Waterway," with an aggregate length of six miles, to say nothing of spurs and laterals, which may be built in future years in connection with large industrial enterprises. The cost of this canal system is estimated at \$4,000,000. It will develop a vast area of tide flats and present unexcelled opportunities for industrial development, with convenient access from both sea and land. Besides the canal system, a number of waterways are to be built and various slips and piers which will provide excellent accommodation for vessels engaged in ordinary commerce. When these improvements shall have been made, the wharf frontage of Tacoma between Point Defiance and Brown's Point will aggregate 42 miles.

Diversity of interest and multiplicity of authority should be courageously combated by her people, and a Port Commission organized with jurisdiction over the entire waterfront, which would ensure its development

along broad, comprehensive lines in accord with the business expected to be handled through the Port in the future. Whether the commission be a creation of the State or the Municipality is not important, so long as it has for object the acquisition and public operation of the facilities of the Port.

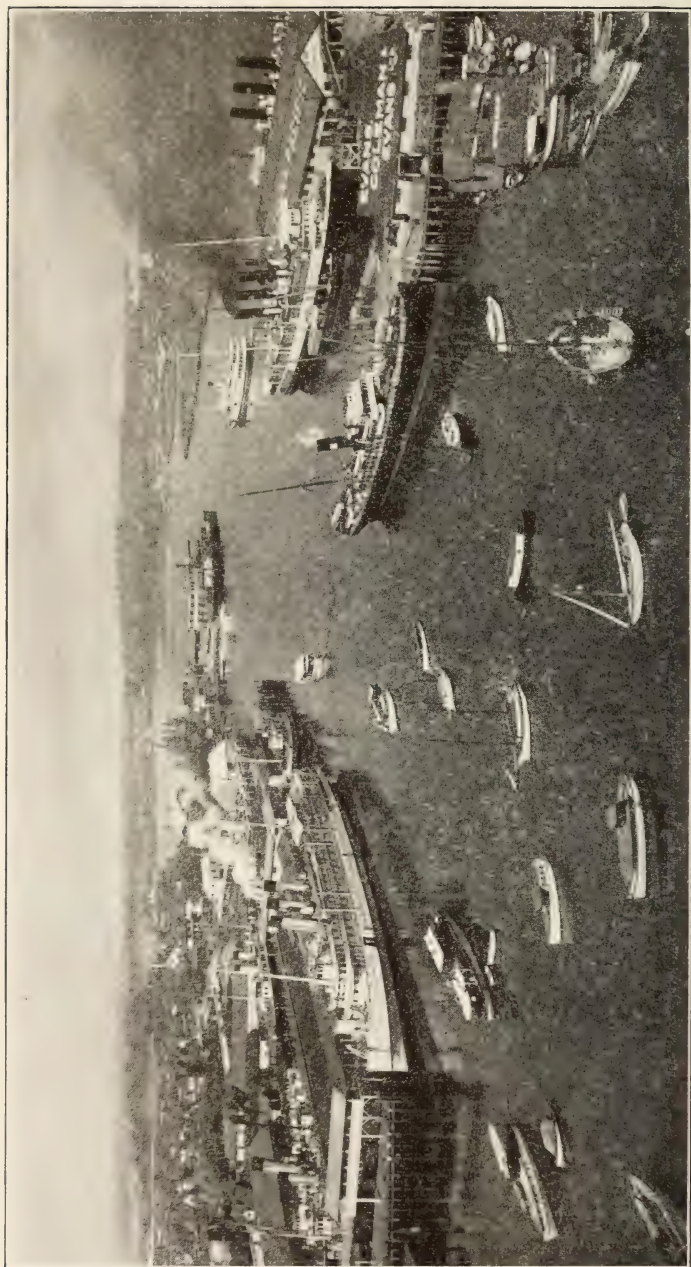
A belt line should also be established by such a Commission at the very outset, because upon such an artery is dependent more than upon any other the despatch and economy of the Port, and the longer the acquisition of such a public utility is delayed the greater the difficulty in solving the problem will become.

VICTORIA.

Victoria, the capital of British Columbia, with a population of 60,000 people, lies at the southern end of Vancouver Island, and at the eastern end of the Juan de Fuca Strait.

The Harbour has its entrance between McLaughlin and Ogden Points, from the latter of which is now being constructed in a southwesterly direction a long break-water, which is expected to shelter a 90 acre area and the docks situated in the outer harbour, where there is from five to seven fathoms, with deep water in the channel leading to the two ocean docks.

The entrance to the inner harbour is between Behren's Island and Shoal Point, through a short but narrow and tortuous channel, the improvement of which is under way, and when completed the corners will have been removed as far as feasible and a low water depth of 20 feet obtained, so that vessels of from 3,000 to 4,000 tons displacement will have safe and easy access.



VICTORIA, B.C.—Harbour.

The spring tides rise from seven to ten feet, and the neaps five to eight feet, increasing 18 to 24 inches under strong winds from the southeast.

The dredging and maintenance of the channels, as well as the buoys and beacons, are carried out by the Department of Marine and Fisheries.

The character of the bed of the harbour is sand, hardpan and rock in some places.

The wharves are divided into three groups, the outer wharves or ocean docks, the inner harbour wharves or that stretch between the entrance of the inner harbour and the E. & N. Railway Bridge, and the upper harbour basin, which is above the Railway Bridge.

The ocean docks, principally used by calling vessels (ocean-going), are situated on the east side near the entrance to the inner harbour, and consist of Rithets' two wharves, called the "Old" and the "New" wharves, providing respectively 1,594 and 1,160 feet of berthage, with a large area of shed room. The general depth of water at these wharves is 33 feet at low tide.

It is in this section of the harbour that developments on an extensive scale are under way, under the supervision of the Department of Public Works.

The first units of the work are a 2,500 feet breakwater and two large docks; all of which are being constructed with rubble mound foundations and reinforced concrete superstructures.

The breakwater, being constructed by the firm of Sir John Jackson, Ltd., of Montreal, will shelter a 90 acre area, and the two new docks are being built close to it inside the sheltered area, with the idea of adding more docks later as the traffic increases. These docks will have a berthing space of from 800 to 1,000 feet long, with

a depth of 35 feet at low water, and are intended only for the largest vessels.

The breakwater, the outer two-thirds of which is built in a depth ranging from 60 to 75 feet at low tide, will have provision for the construction of a lighthouse at its end, and will cost about \$1,900,000.

The wharves of the inner harbour, with a frontage of about 15,000 lineal feet, and a large shed area, lie along the



VICTORIA, B.C.—Outside of Breakwater at shore end, showing facing of large granite blocks.

city front, and the depth at low tide ranges from 16 to 20 feet, the latter being the objective point throughout.

Around the upper inner harbour there are twelve wharves, owned by industrial concerns, with a frontage of 1,600 feet, and a shed floor space of 20,000 feet.

There are no railway connections at Victoria wharves, the prevailing type of port business being from ocean ship to coaster, in which manner most of the cargo is distributed throughout the island. Cargo for local con-

sumption is conveyed to its destination mainly by motor truck, or to the cold storage warehouses, of which the city owns two, with a capacity of 135,000 cubic feet.

Steamers use their own winches for loading and discharging cargo.

While there is no dry dock at Victoria, the graving dock belonging to the Dominion Government being located at Esquimalt, four miles distant, the following facilities are available for ship building and general repairing:—

In the upper harbour or basin are located the works of the Victoria Machinery Depot, having a frontage of about 360 feet and covering an area of about 136,000 superficial feet, with a cradle 280 feet long by 60 feet beam, providing dry dockage for vessels up to 3,000 tons burthen. The machine shops are fitted up with every up-to-date appliance for the repairing of vessels.

On the old Indian Reserve are also situated the marine ways of Wm. Turpel & Son. The cradle is 150 feet in length, with 35 feet beam, and facilities are provided for docking and repairing boats of suitable size.

Hutchison Bros. & Co., the Robertson Iron Works, and the Ramsay Machine Works are also equipped with modern machine shops and foundries to efficiently handle marine repair work.

There is a wireless telegraph station at Gonzales Hill, on the southern shore of the Port, which can communicate with vessels 250 to 300 miles distant.

The principal industry of Victoria is lumber, and her exports—lumber, coal, whaling products, salmon and other fish and fruits.

The fire and police authority of the Port is the City of Victoria, the police service being anything but satis-

factory, as may be judged from the number of petty thefts committed within the Port District.

A Harbour Master, appointed by the Department of Marine and Fisheries, is in charge of the movement of vessels in the Port.

The entire dock development of Victoria has been the result of the investment of private money, the wharves being exclusively under private control and ownership, as far as port facilities are concerned.

Pilotage is under the control of the Victoria and Esquimalt Pilotage Authority and payment of pilotage is compulsory.

The Quarantine Station for Victoria is at Williams Head in Parry Bay, part of Royal Bay or Roads, where vessels are required to report. This station has a wharf 480 feet long with a depth from 25 to 30 feet alongside.

ESQUIMALT.

Esquimalt Harbour, four miles distant from Victoria, is entered from the Strait of Saint Juan de Fuca, the immediate entrance being from the Royal Roads (a fine sheet of water affording excellent anchorage), and is three cables wide, opening out immediately to an extensive harbour, having a general depth of six fathoms, and extending $1\frac{1}{4}$ miles northwest. On the eastern side of the harbour are Constance Cove and Plumper Bay, in the former of which are the Government naval establishments.

The yard of Yarrow, Ltd., is particularly well placed for carrying out full repairs to hulls and machinery of vessels, and also for undertaking work in connection with the docking of steamers for cleaning and painting.

Adjacent to this yard is the site of the new Government dry dock, the construction of which is to be under-

taken by the Dominion Government at an early date. The dimensions of the new dry dock will be 1,150 feet long by 120 feet wide, and, when completed, will be one of the largest and best equipped in the world. In addition to the dry dock, there will be a wet basin, in which vessels will be accommodated when undergoing repairs.

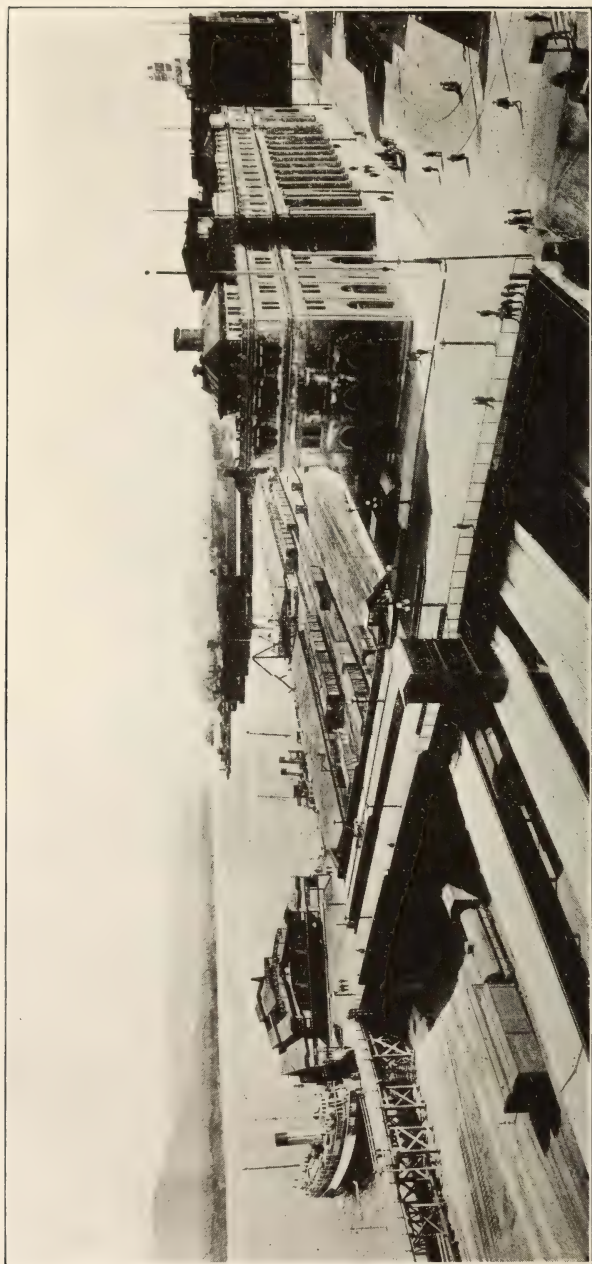
In this harbour is the Government graving dock, 480 feet in length by 90 feet in width at coping level, and 65 feet wide at the entrance, with a depth of water of $26\frac{1}{2}$ feet. This dock was built by the Imperial Government, and has outlived its usefulness to some extent, not being capable during the past summer of accommodating British and Japanese war vessels which were berthed in the port for extensive repairs.

The B.C. Electric Ry. gives quick connection between Esquimalt and all parts of Victoria.

VANCOUVER.

The Harbour of Vancouver, British Columbia, described in ancient admiralty records as "the finest great harbour that indents the coast of British Columbia," opens off the Strait of Georgia into Burrard Inlet, a few miles northeast of the mouth of the Fraser River, and extends in a line from Atkinson's Point on the north to Grey Point on the south, from which line east for about six miles stretches the "Outer Harbour," with an almost uniform width of five miles.

The "Central Harbour," extending from the First to the Second Narrows, a distance of five miles, with a maximum width of two and a half miles, is entered through the First Narrows, which has a depth of from 35 to 72 feet at low water, and a width of 450 feet, now being increased to 1,200 feet.



VANCOUVER, B.C.—Looking up Harbour—Canadian Pacific Railway Company's New Depot in foreground.

What is termed the "Industrial Harbour" is located between the Second Narrows and Port Moody, a distance of something like eight or nine miles, and forms part of the Harbour of Vancouver, so far as its foreshore and navigable waters are concerned, although Port Moody is incorporated as a city under a separate charter. Extensive industries are located on the north and south shores of this stretch, which is removed a convenient distance from the centre of passenger and merchant shipping. It has many miles of unusually suitable foreshore, with trackage and transportation facilities, and is destined to become Vancouver's chief manufacturing centre.

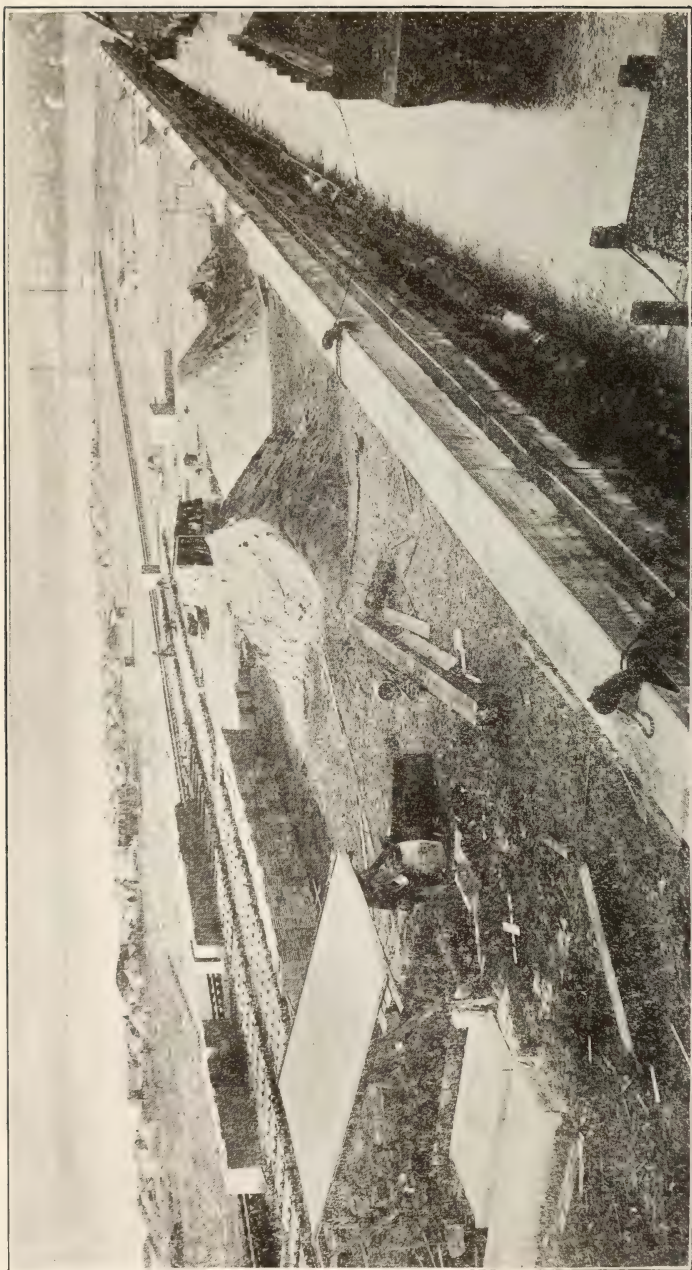
In all, Vancouver has 98 miles of waterfront, practically all of which is suitable for industrial and commercial purposes, with deep water and an almost entire absence of submerged rocks, shoals or other dangers to navigation.

The bed of the harbour is mostly of a blue clay formation, and dredging is done by the Department of Public Works in the Narrows, the only dredging required in the harbour proper being at the wharves, and this is carried out by the owners of the same within the pierhead line.

Lighthouses, beacons, etc., are provided and maintained by the Department of Marine and Fisheries.

The range of the tide is 13 feet springs, and 11 feet neaps, and the strength of the same at the narrowest point of the channel at the First Narrows is from four to eight knots.

The Port is the western terminus of the Canadian Pacific Railway Co. The Great Northern Line from Washington State runs into the Port, and the Canadian Northern Railway has just completed its system eastward to connect with the portion of the line built in British Columbia. The Grand Trunk Pacific has steamboat connections



VANCOUVER, B.C.—Showing construction of new Government Wharf, now completed. 73

with Prince Rupert, its terminus on the Pacific Coast, and the Pacific Great Eastern also operates to the harbour. The railway connections to the wharves and piers are very good, and the Harbour Commission has at present under consideration the establishment of a belt line, over whose tracks the cars of every railway will be switched to the different berths.

The principal exports of the Port are lumber, fish and minerals, and the tonnage of goods handled through the Port for the year ended 31st March, 1915, was 795,908 tons weight.

The number and tonnage of vessels arriving for the same year were:—

Coastwise.....7,668 vessels, 3,305,458 tons.

Foreign.....1,463 vessels, 1,692,314 tons.

Total 4,997,772

The types of port business in operation in the Port are:—

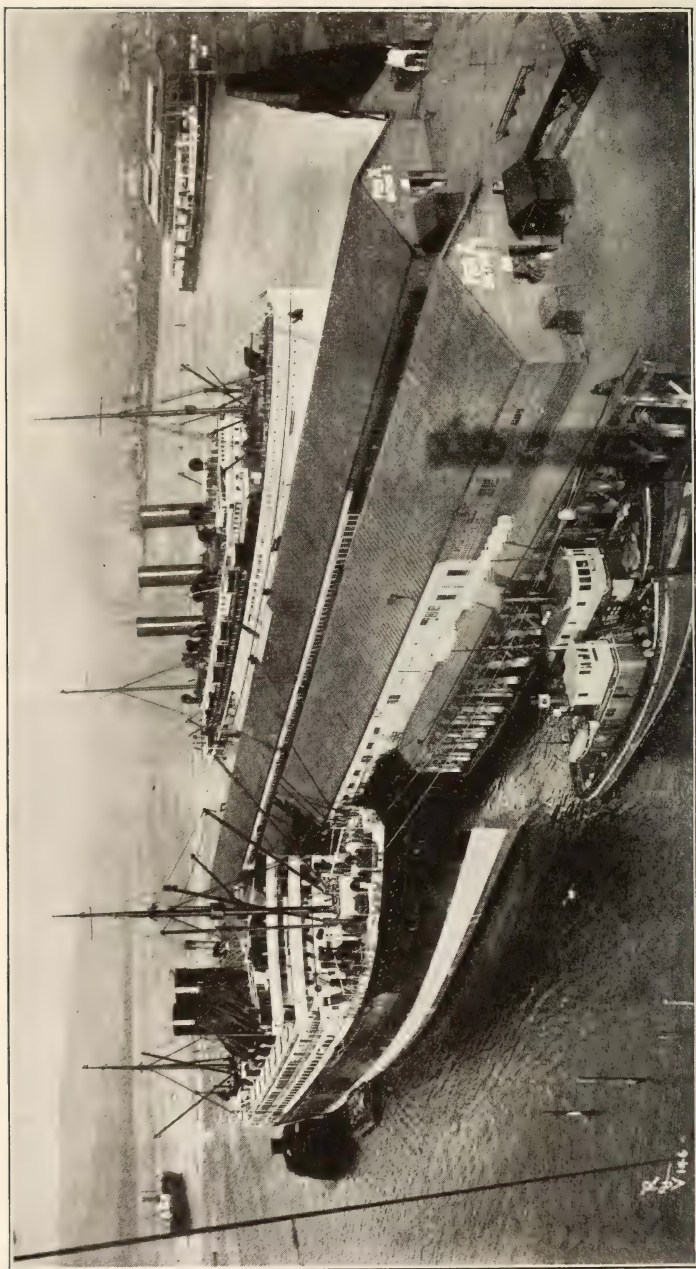
Ocean ship to coasting ship.

Ocean ship to railways direct.

Ocean ship to warehouse by vehicle.

The Harbour consists chiefly of piers and riverside quays, built of uncreosoted timber piles, with the exception of the Great Northern wharf and the new Government pier, which are of similar construction to our Montreal piers, viz., cribwork substructure, concrete superstructure, filled in solid.

Vancouver is the home port of the Canadian Pacific Railway Company's Trans-Pacific Empress steamers, the Canadian Pacific and Grand Trunk Pacific coasting vessels, and a vast number of small tonnage passenger and freight vessels plying up and down the coast.



VANCOUVER, B.C.—Australian and Oriental Boats at Pier "A."

The Royal Mail steamers of the Canadian-Australian Line carry passengers and freight to and from the Antipodes on a 21 day schedule, and the Blue Funnel boats, the largest freighters afloat, ply round the world, and a fleet of big vessels of the Andrew Weir Line maintain a regular schedule between Vancouver and the Orient. Freight communication is provided between New York and Vancouver by a line of British vessels, and the Harrison Line and a service to Antwerp places Vancouver in direct touch with the ports of Europe. The East Asiatic Co. and the American Hawaiian Steamship Co. also call regularly at the Port, and an extensive coasting trade is maintained by the Canadian Mexican Pacific Steamship Co., the Pacific Coast Steamship Co., and many smaller shipping concerns.

The present wharfage accommodation for vessels in the Port aggregates about 12,000 lineal feet.

The sheds upon the wharves in Vancouver Harbour are all built of wood, and, with the exception of those of the Canadian Pacific and the Grand Trunk Pacific, are one storey.

The lighting of the wharves and piers is done by the owners of the same, who also pay taxes to the municipality.

There are no dry docks in the Port at present, although the Dominion Government have practically determined to have one established here within a short time, as will be described later.

The B.C. Salvage Co., at the eastern end of the city, has a marine railway, where vessels are hauled out and repairs made.

At North Vancouver, on the opposite side of the harbour from the city, are the Wallace Shipyards, where vessels are built and repaired. The slips at this yard are

capable of hauling out vessels of 2,000 tons, dead weight, and are fitted with all the most modern appliances for effecting repairs.

Vessels are loaded and unloaded in the harbour by steam cranes, derricks and ships' tackle, a pair of shear legs of 30 tons capacity being provided on the North Vancouver shore, to which vessels are required to move when desirous of discharging any heavy lifts.

Organization.—By an Act of Parliament of May, 1913, the Harbour of Vancouver was placed under the jurisdiction of a Harbour Commission, consisting of three members, the Act being a copy of the Montreal Harbour Commissioners' Act.

The Commissioners have in hand at present the reclaiming of 42 acres of tide flats in False Creek, which is an arm of the sea opening off the outer harbour. The flats were crown granted to the Commissioners, and when the work is completed the area will be used for industrial and warehouse sites with trackage and waterfront which will be rented on long leases at low rentals. More applications, it is understood, have been received for these sites from industrial concerns than the reclaimed area will accommodate.

The Dominion Government has nearing completion a new reinforced concrete wharf, 800 feet in length with a frontage of 300 feet, and a depth of 35 feet at low water. It is situated in the central section of the harbour and is of a form of construction practically new to the Pacific Coast, consisting of cribs reinforced with concrete and a heavy mass wall of concrete on top.

This wharf will be equipped with two sheds 800 feet long by 80 feet wide, of the most modern type, and with up-to-date appliances for loading and discharging purposes.

It is understood that upon completion it will be handed over to the Harbour Commissioners to operate.

Grain Elevator.—Adjoining this wharf is a grain elevator now under construction and expected to be ready for handling grain by the 1st January. The elevator has a total capacity of 1,250,000 bushels, a receiving capacity of 20,000 bushels per hour, and a loading capacity of 60,000 bushels per hour. The sacking plant is capable of sacking from 3,000 to 5,000 bushels per hour.

Dry Dock.—Among the important acquisitions which Vancouver is looking forward to is a dry dock and ship-building industry, for which arrangements have been about completed. The need for such a concern has been frequently demonstrated, and in subsidizing the company which has received the contract the Government was careful to look ahead, as is indicated by the fact that the price is \$5,458,418 and the site secured comprises 80 acres.

The City of Vancouver maintains the fire and police services within the Port.

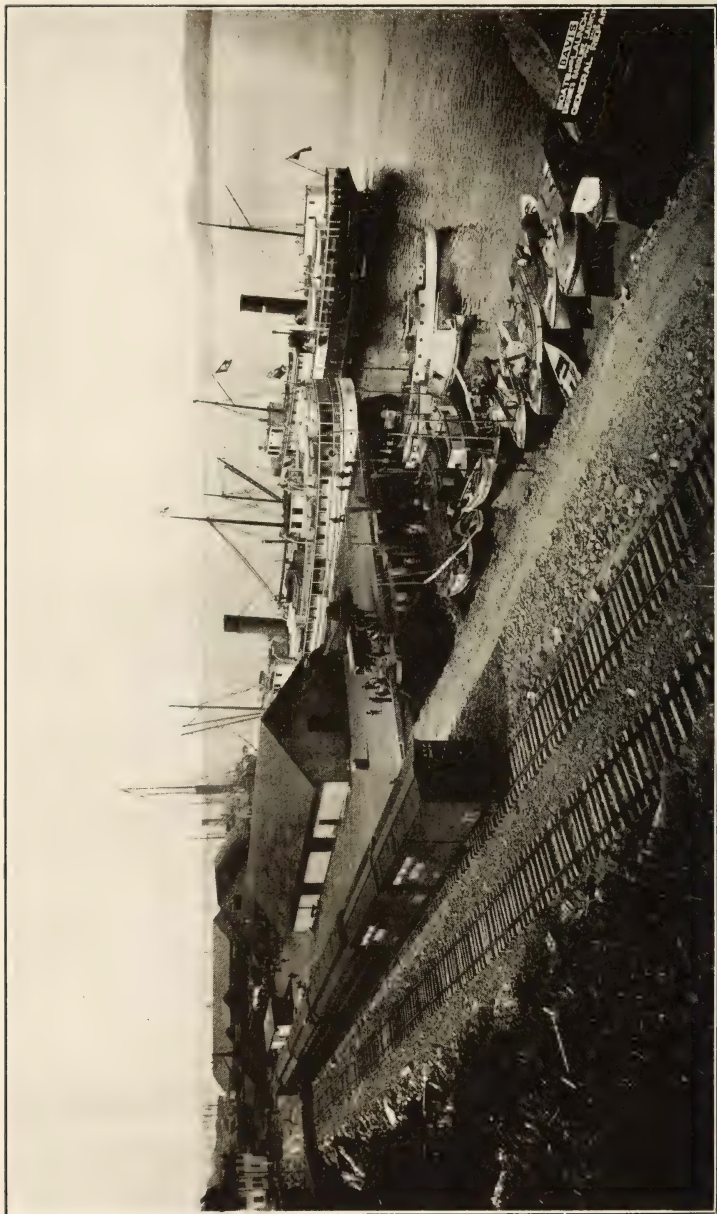
A Harbour Master has been appointed by the Harbour Commission, but the pilots come under the Vancouver Pilotage authority, and payment of pilotage is compulsory.

Vancouver is Seattle's greatest rival for commercial supremacy north of Portland. Its strategic location is good, being at the outlet of the second greatest river of the Pacific Coast, and in the fish and lumber trades, Vancouver's competition is most formidable.

Her population at present is 106,000.

PRINCE RUPERT.

Prince Rupert Harbour, British Columbia, is situated on Kaien Island, within a well-sheltered inlet on the inside passage to Alaska, 18 miles north of the mouth of the



PRINCE RUPERT, B.C.—General View of the Harbour.

Skeena River. The northern entrance between Lima Point and the Kinahan Islands is about $1\frac{1}{2}$ miles wide, which continues to almost the boundary of the town, opposite which the width is about one mile. The depth of water in the channel is from 17 to 23 fathoms, with 6 fathoms alongside the wharves.

The area of the entire inlet in front of and back of the island is about 27 square miles, and that of the shore line is about 80 miles.

In the year 1907 the place where Prince Rupert now stands was a wilderness of timber-covered land, there being no connecting steel between her and civilization, and the only way in and out was by steamer.

Having been selected as the terminus of the Grand Trunk Pacific Railway, the past eight years have accomplished great things, a town having sprung up with a population at present of 6,000 people.

The Grand Trunk Pacific Railway have constructed wharves with a frontage of 1,685 feet at various angles with the waterfront, first angle 320 feet, second 350 feet, third 475 feet, fourth 360 feet, fifth 180 feet, as well as a coal dock 300 feet in length.

The Provincial Government wharf is 600 feet long by 100 feet wide, with 25 feet of water at low tide.

Single storey wooden sheds are located on the above wharves.

The Department of Marine and Fisheries in 1912 completed a lighthouse depot on Digby Island, with wharves, piers, workshops, officers' quarters, storehouses, buoy sheds, etc., from which the lighthouse and buoy services of Northern British Columbia are attended.

The anchorage in the harbour is good for vessels of



PRINCE RUPERT, B.C.—View of Grand Trunk Pacific Dry Dock and Ship building Equipment.

any size or draught, and no dredging is necessary on account of the great natural depth of water.

A fuel oil depot consisting of five storage tanks, docks, warehouses, pumping station, etc., where, weekly, tank steamers of large capacity are landing cargoes of oil fuel necessary to the fish trade and the railway, has been constructed by the Imperial Oil Co., oil being practically the only fuel used on vessels and railways in that part of the country.

The Grand Trunk Pacific Dry Dock Co. have completed the dry dock, which has been under construction for over two years, and are now ready for business. They make a specialty of repairs for the fish trade and also build small coasters for the general trade, besides undertaking general repair work.

The dry dock is of the floating type and is the most up-to-date on the Pacific Coast. It is virtually three docks in one, and can handle a ship having 20,000 tons displacement, with a length of over 600 feet, and drawing 35 feet of water. Built in three sections, it can be disconnected and handle vessels of smaller capacity economically. The smaller units will lift 5,000 tons, length 165 feet; the larger unit 10,000 tons, with a length of 270 feet.

In addition to the dry dock there are five other features of the plant, viz., the foundry which is able to make castings as heavy as 12 tons, a boiler shop for marine repairs, as well as for the construction of boilers, a machine shop, a ship shed and carpenters' shop, and a power house equipped with two large turbo-generators, and a 1,500 feet air compressor. Necessary cranes (one of 60 tons capacity) are also included in the equipment of this most important port adjunct.

Fishing is the largest and best of Prince Rupert's young industries. A year ago her shipments were next to nothing, while in September, 1915, returns show that over 2,000,000 lbs. of halibut alone was landed at the Port, and nearly all of which was shipped over the Grand Trunk Pacific to the great centres of the east. The citizens of Prince Rupert, in order to foster this trade, have under contemplation at present the expenditure of \$30,000 on a municipal fish wharf at Seal Cove, in addition to which the City is guaranteeing the interest on the cost of building a cold storage plant, city controlled as to rates, charges, etc., to be leased for a term of years at a rental only sufficient to cover interest charges. The installation of such a plant would, it is expected, be of the utmost value in still further attracting the independent American fishermen to the Port, and furnish competitive buyers, the fishermen thus being in a position to command better prices for their products.

The halibut shipments which were formerly all handled through Seattle are now to an increasingly large extent coming through Prince Rupert, owing to her proximity to the halibut banks. Her present fish storage capacity is 13,600,000 lbs.

The Port of Prince Rupert is privately administered, the waterfront, as already shown, being practically held by the Railway Company.

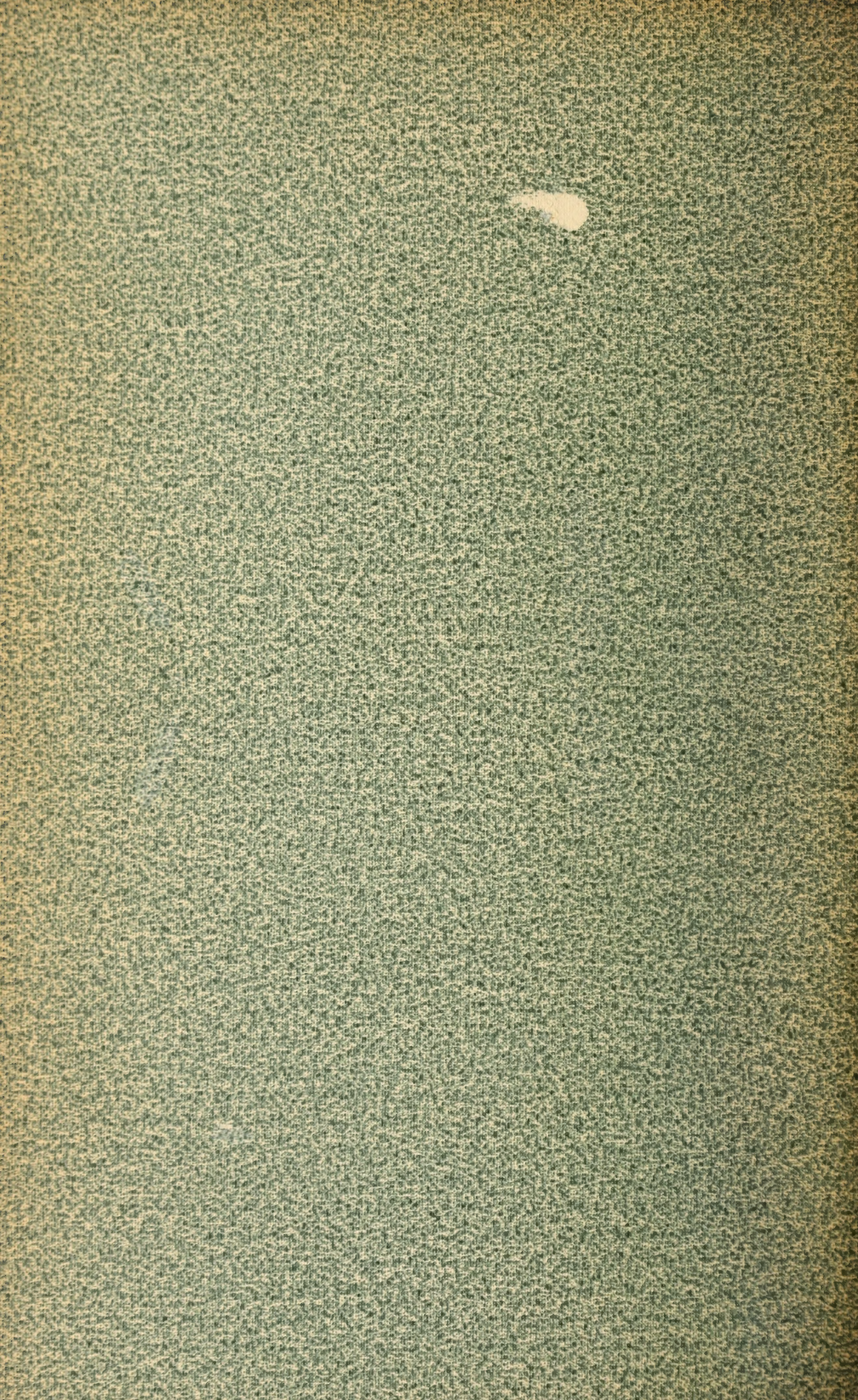
Her geographical position, however, gives her plenty of waterfront, there being some 30,000 feet suitable for dockage, etc., all of which can be leased on fairly reasonable terms by bona-fide industries.

The police and fire protection of the Port is maintained by the City, which also provides electric light, power, water and telephone service.

Pilotage is not compulsory, but pilots may be obtained at Nanaimo when required.

A Harbour Master, appointed by the Department of Marine and Fisheries, controls the movement of vessels in the Harbour.

Prince Rupert's position as to the markets of the Orient and Siberia, toward which the eyes of the manufacturing world are turned at the present time, is an excellent one. It is the westernmost as well as the northernmost trans-continental terminus, and being 500 miles nearer the Orient than any other terminus on the Pacific, situated in the very heart of the salmon, whale and halibut industry, among inestimable quantities of virgin timber, her future as a port and a great transshipping and distributing centre is assured.



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